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Pyo et al.

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(54) **DISPLAY DEVICE**

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(73) Assignee: **LG ELECTRONICS INC.**, Seoul (KR)

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G06F 1/16 (2006.01)

(52) **U.S. Cl.**

CPC **G06F 1/1652** (2013.01); **G06F 1/1656** (2013.01)

(58) **Field of Classification Search**

CPC G06F 1/1652; G06F 1/1656; G09F 9/301
See application file for complete search history.

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(57) **ABSTRACT**

A display device is disclosed. The display device of the present disclosure may comprise: a flexible display panel; a panel roller which is elongated and on or from which the display panel is wound or unwound; a housing in which the panel roller is accommodated, wherein while the display panel is unwound from the panel roller, the display panel descends below the housing; and a board case which is disposed behind the display panel descending below the housing, and of which the front surface is covered by the display panel while the display panel descends.

8 Claims, 40 Drawing Sheets

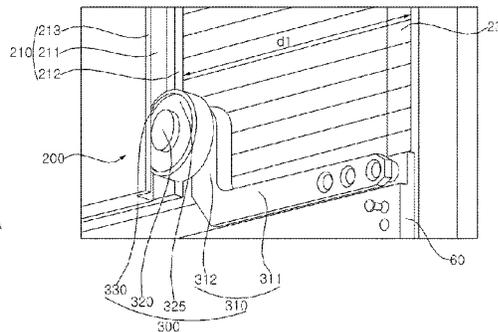
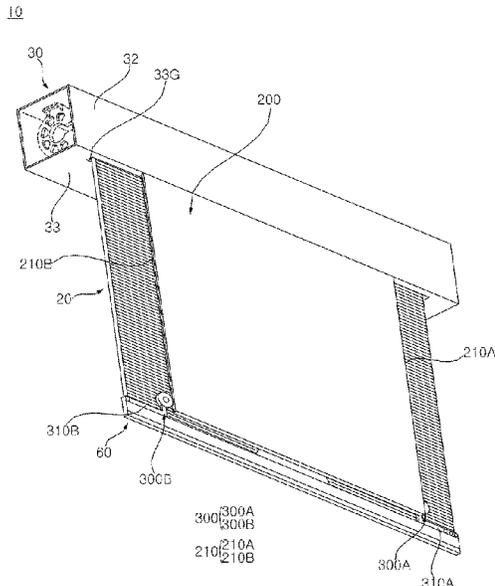


FIG. 1

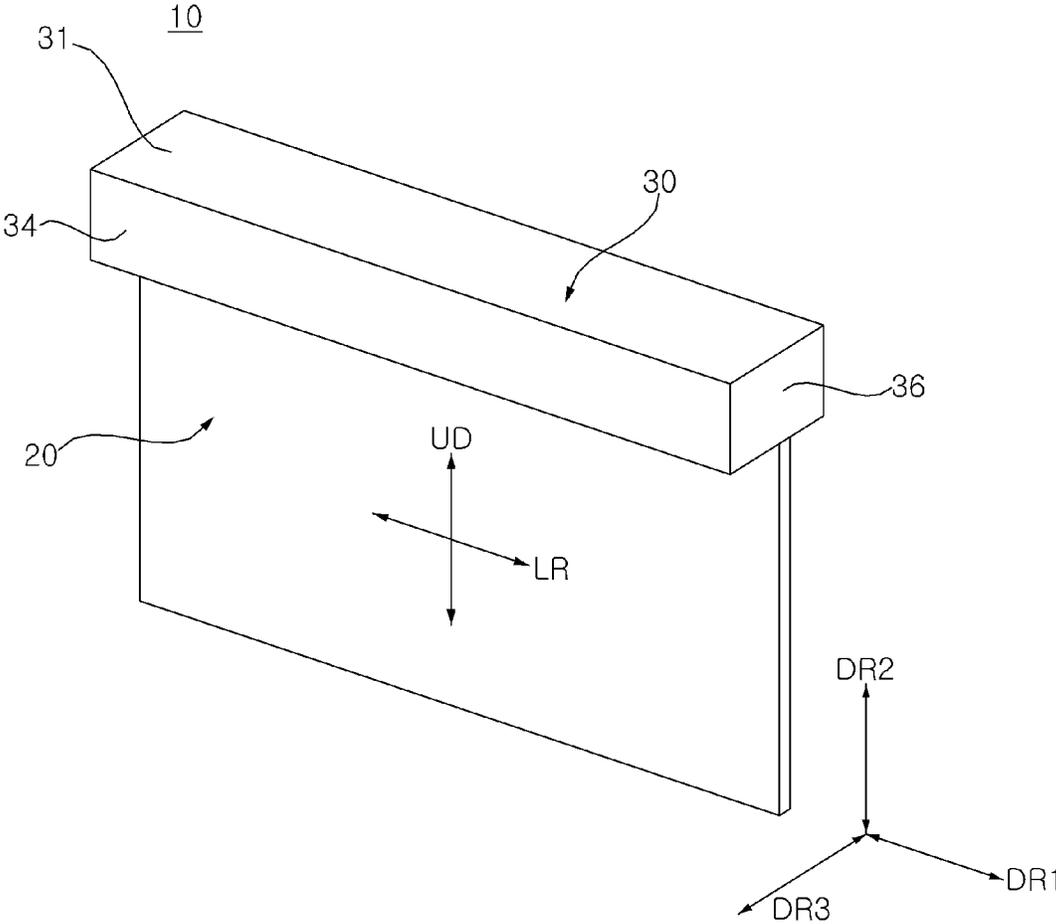


FIG. 2

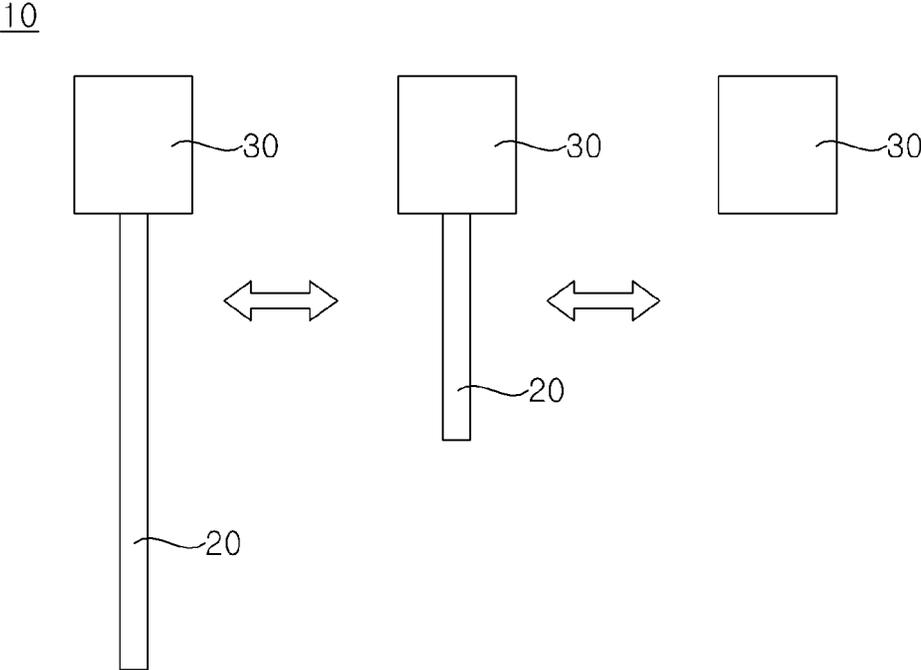


FIG. 3

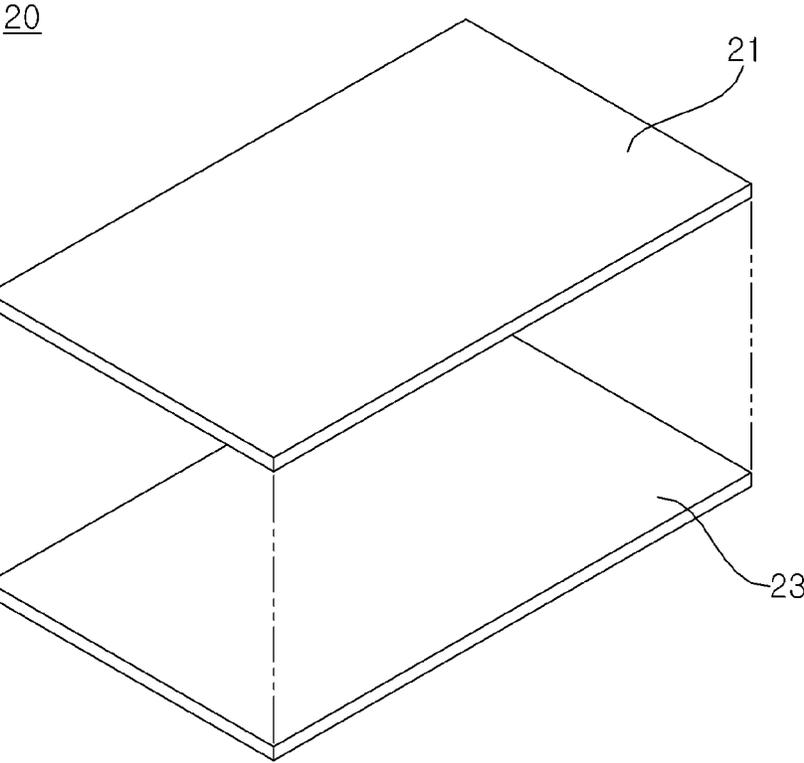


FIG. 4

20

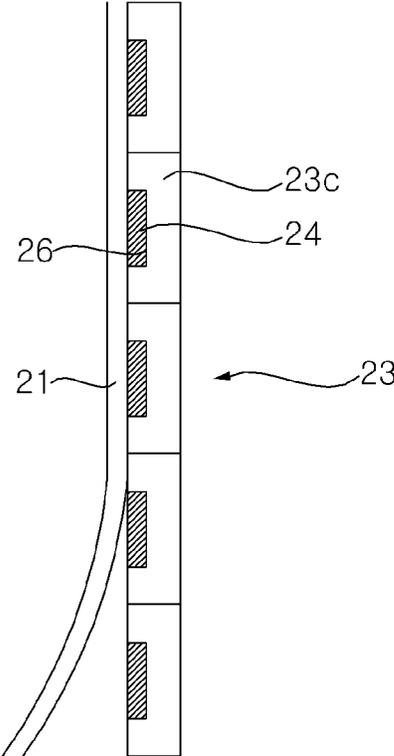


FIG. 5

20

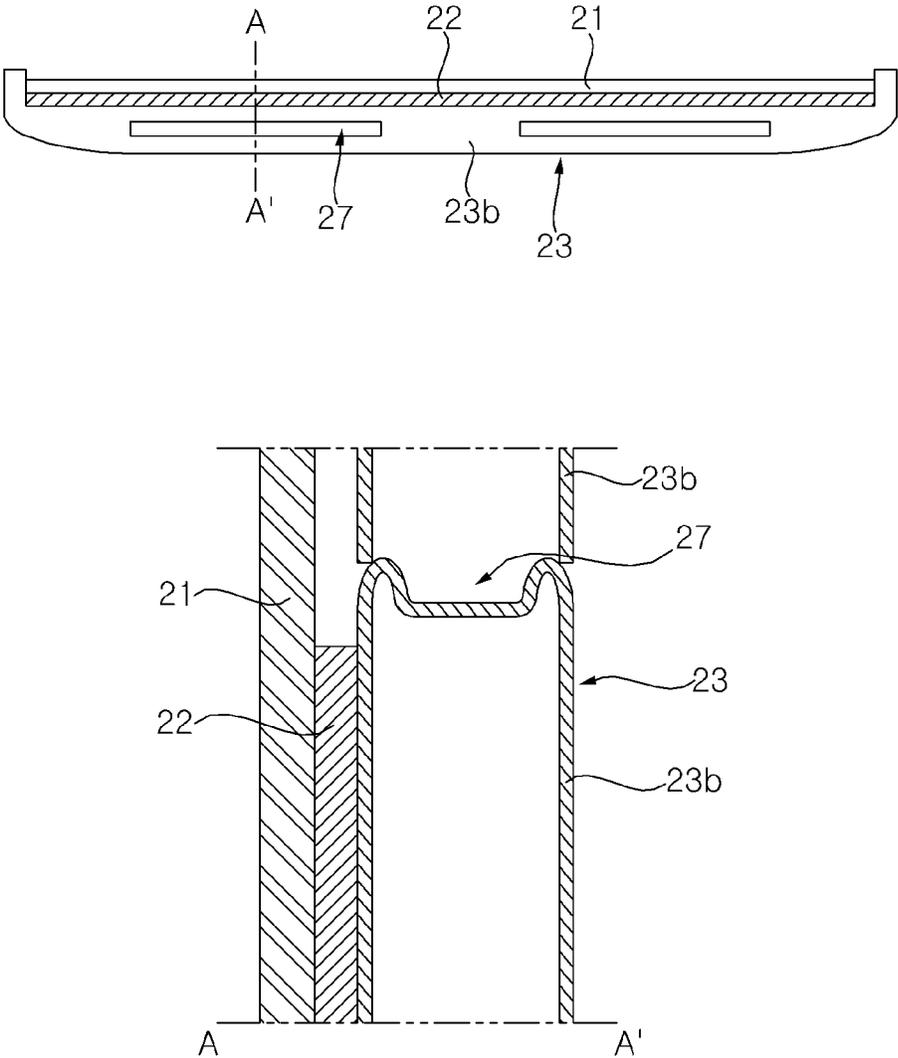


FIG. 6

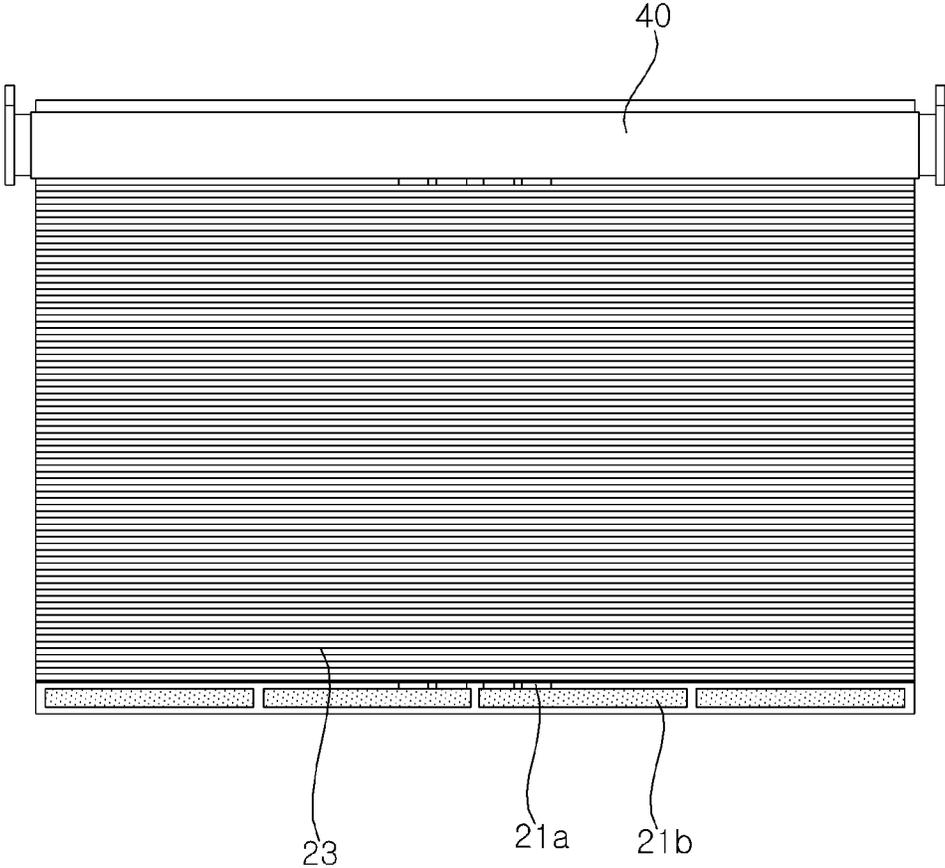


FIG. 7

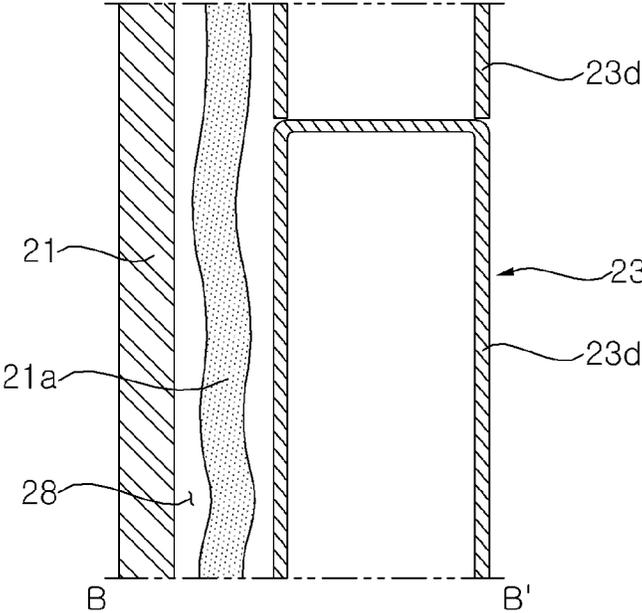
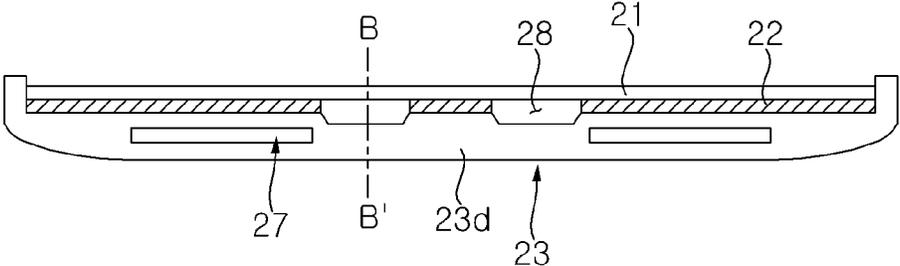


FIG. 8

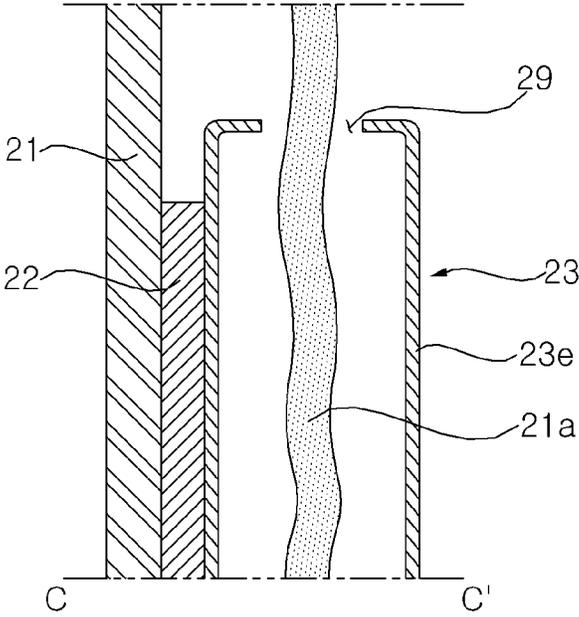
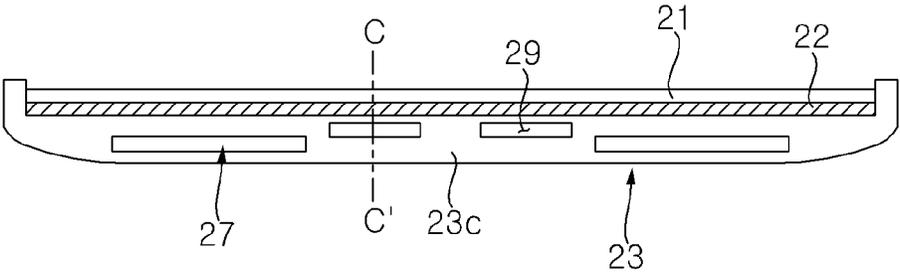


FIG. 9

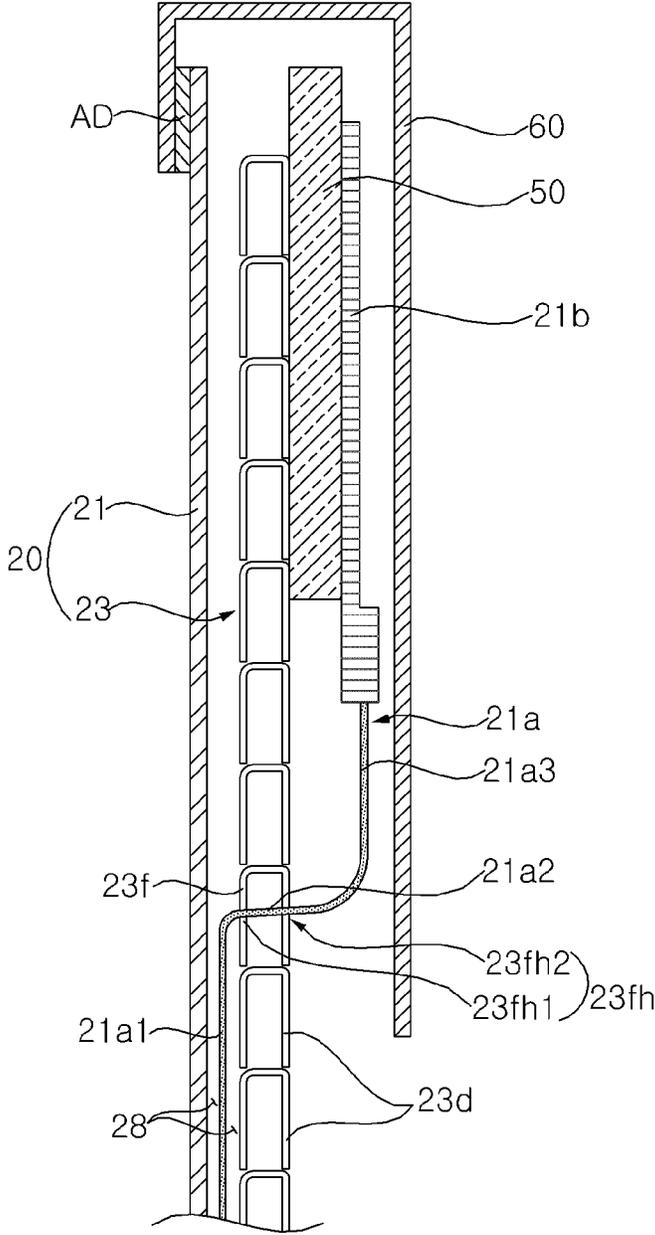


FIG. 10

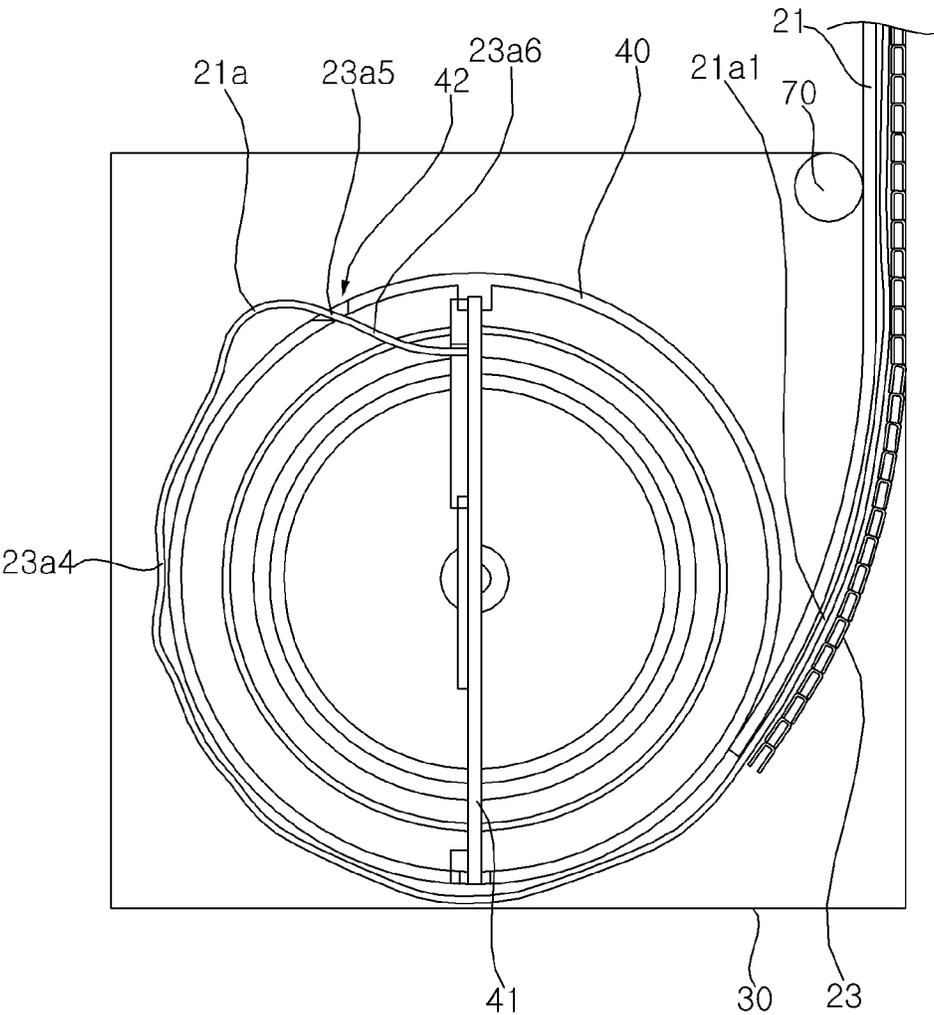


FIG. 11

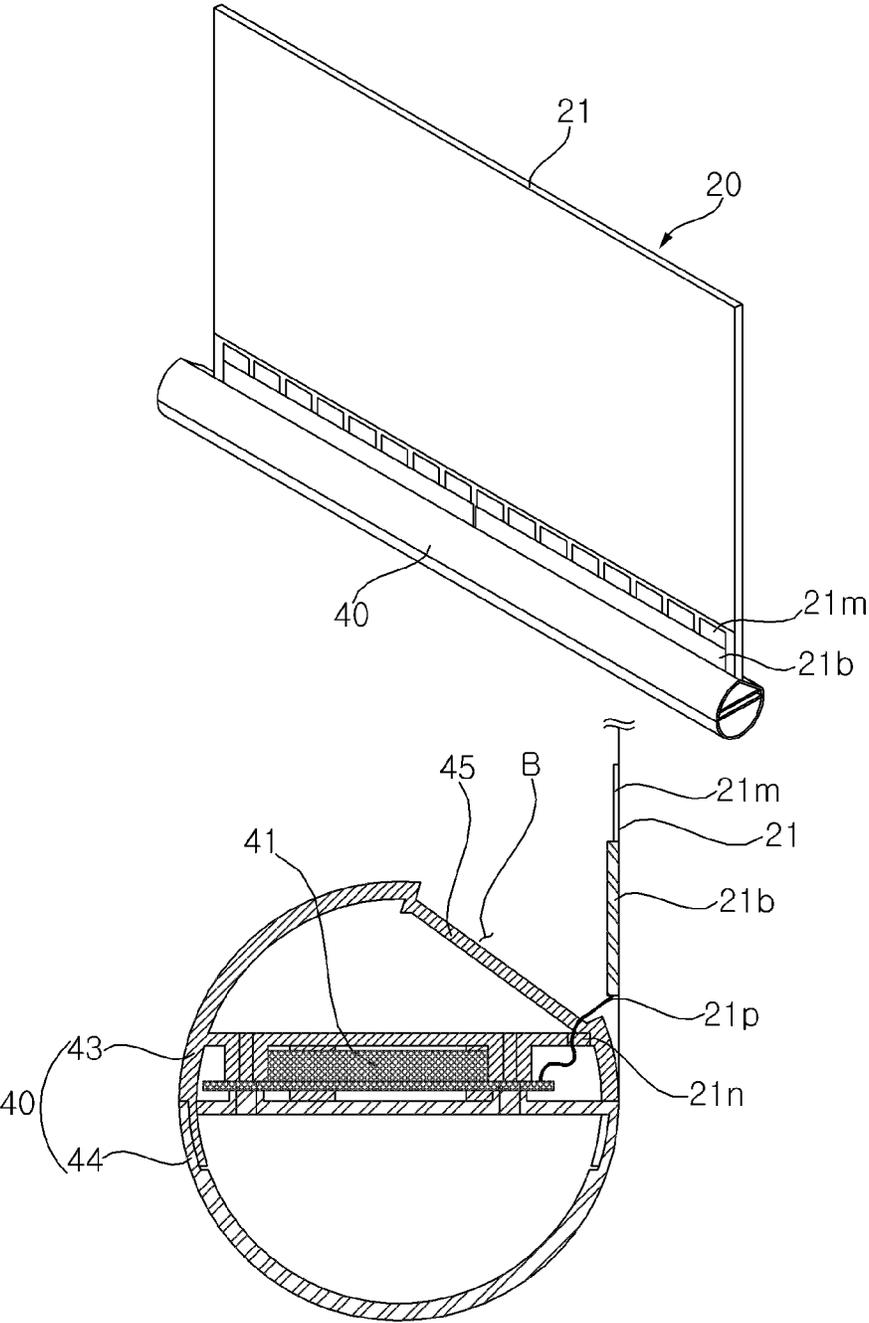


FIG. 12

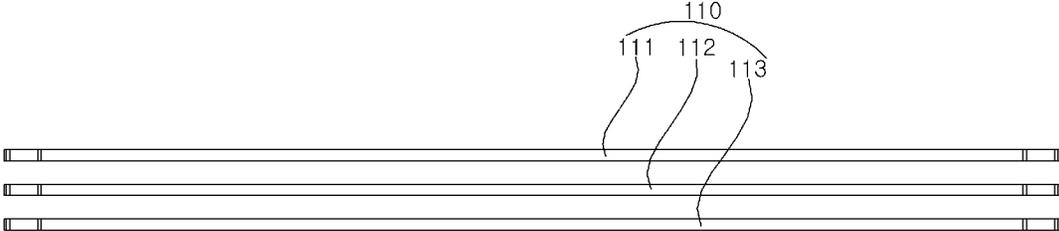


FIG. 13

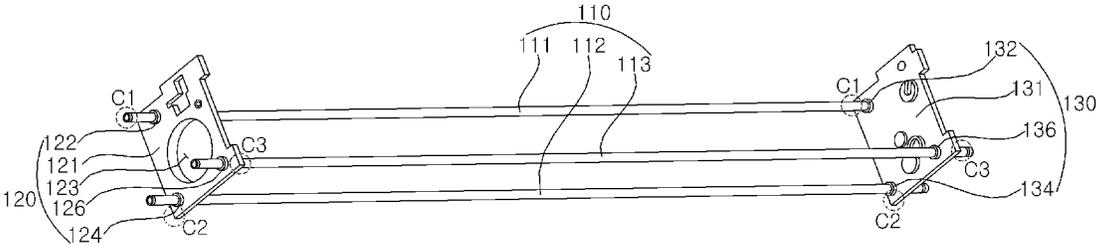


FIG. 14

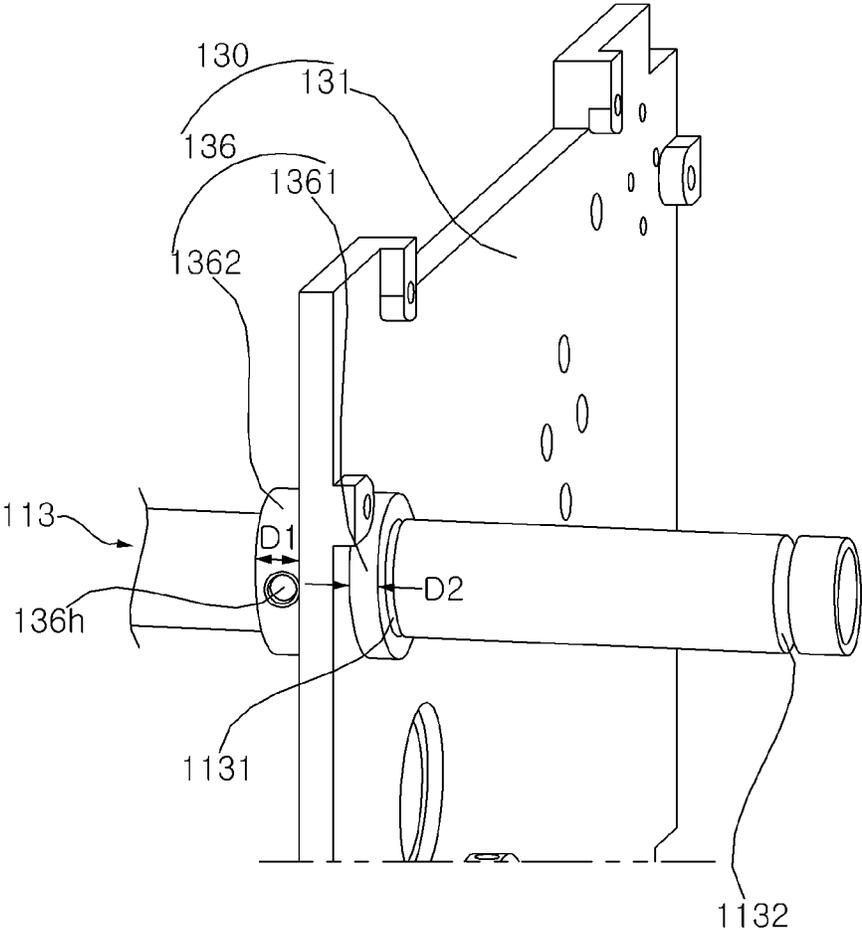


FIG. 15

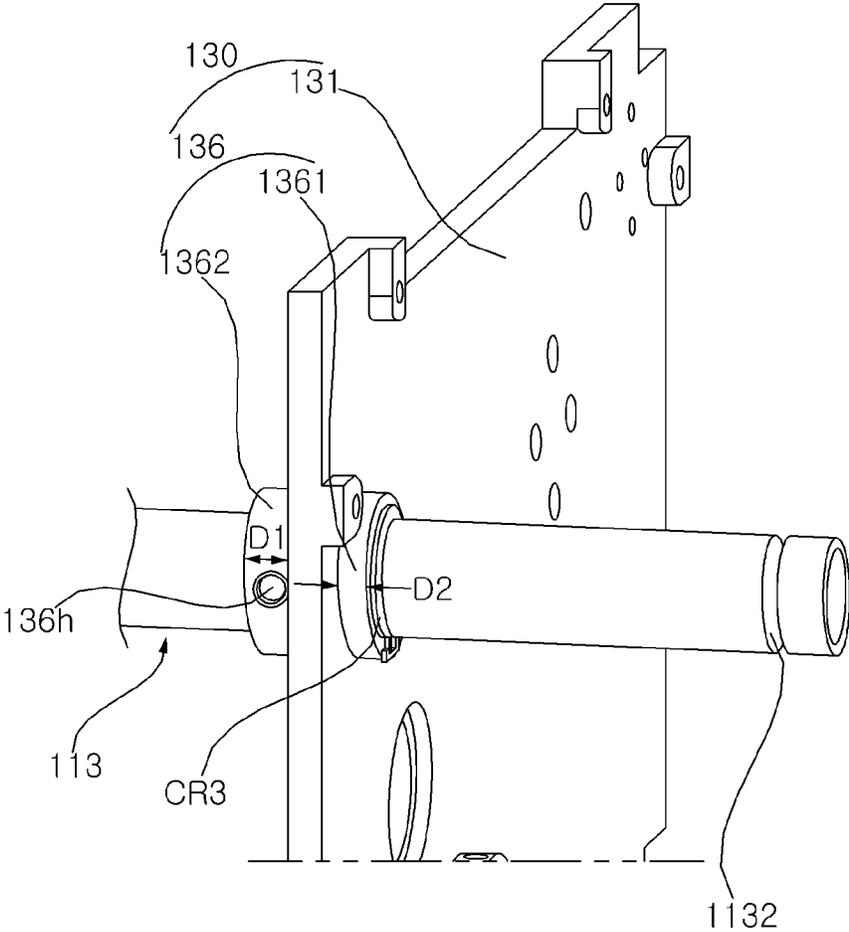


FIG. 16

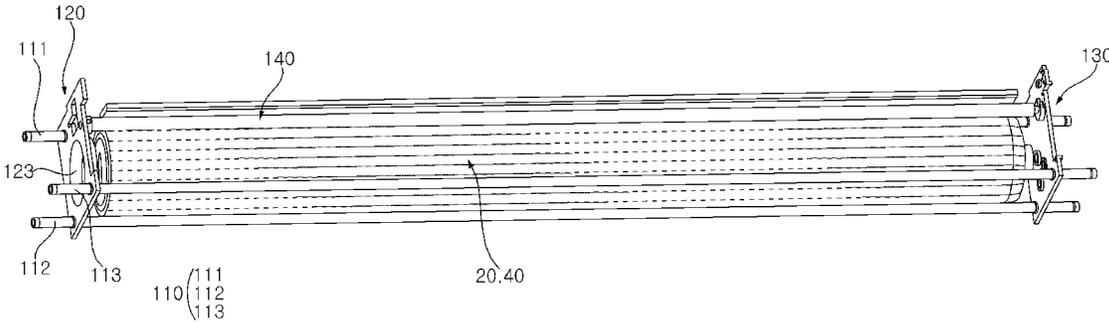


FIG. 17

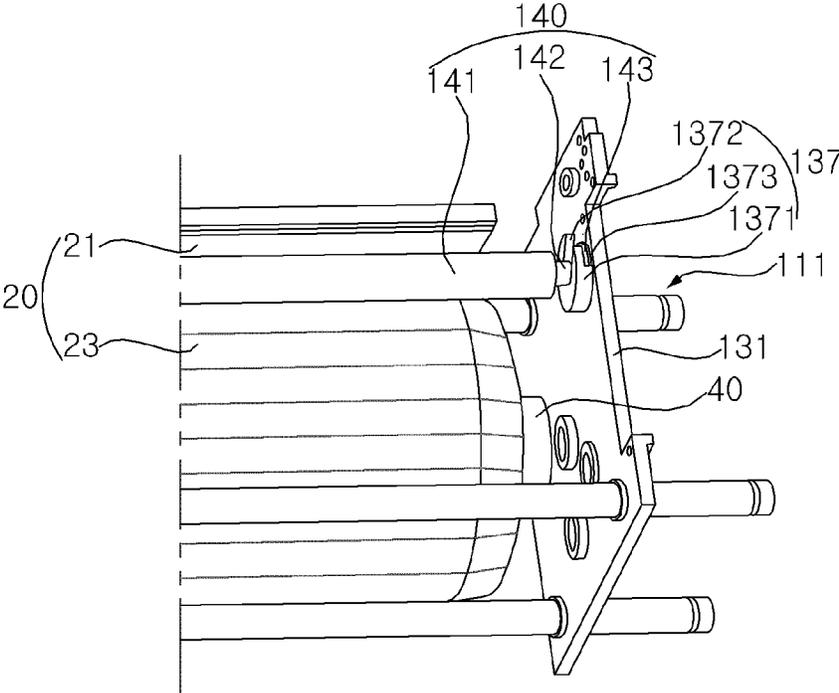


FIG. 18

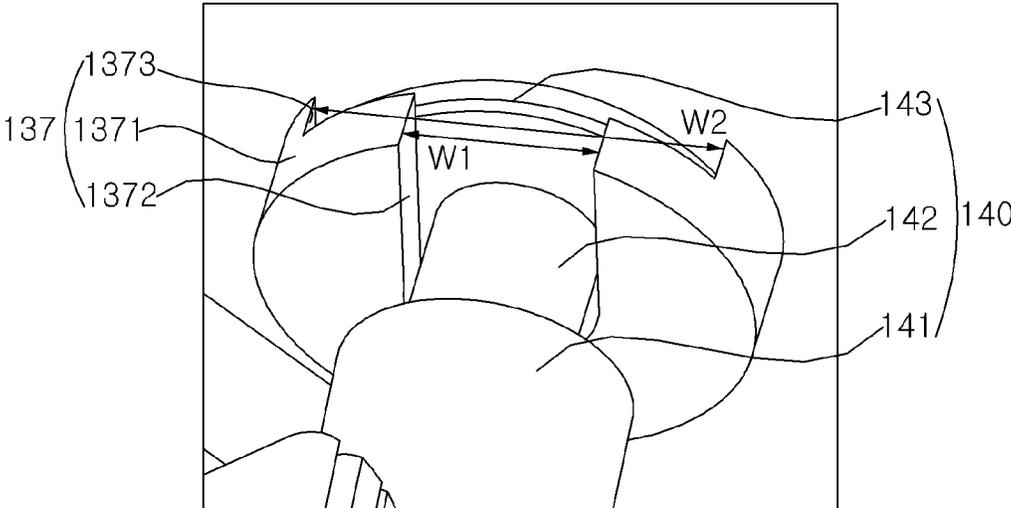


FIG. 19

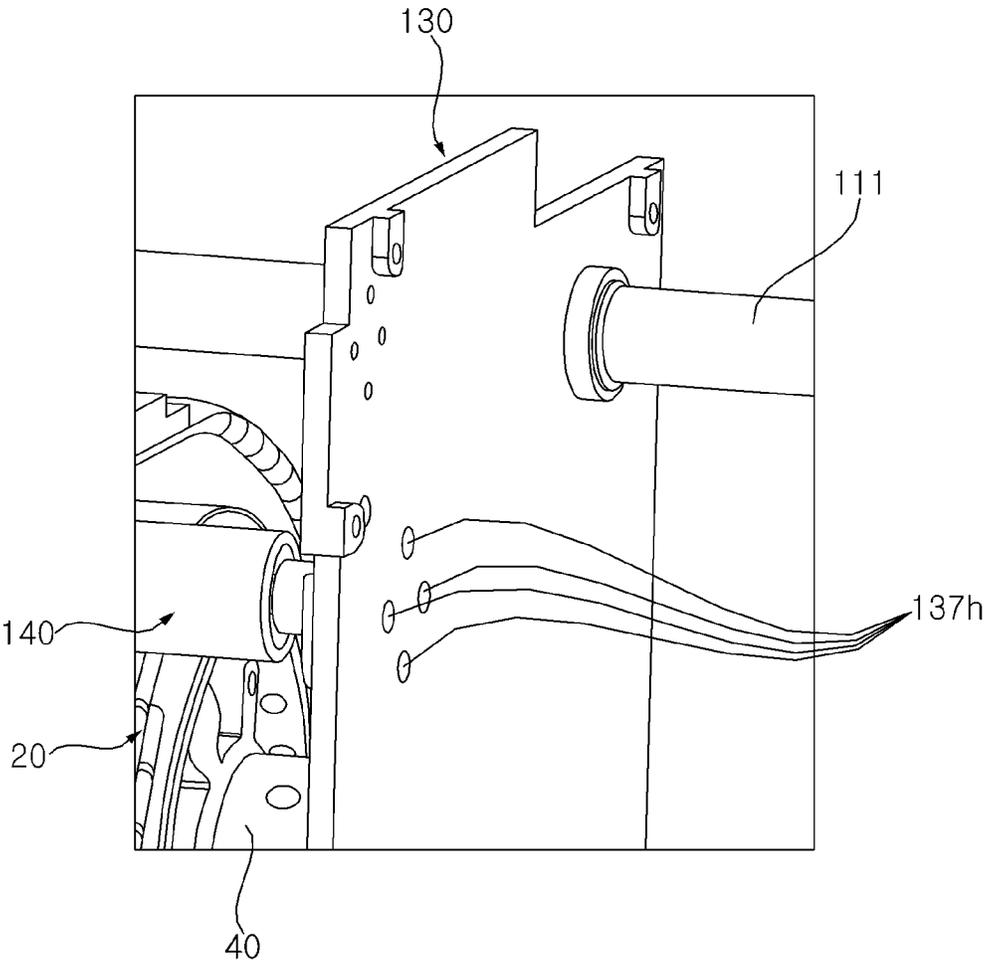


FIG. 20

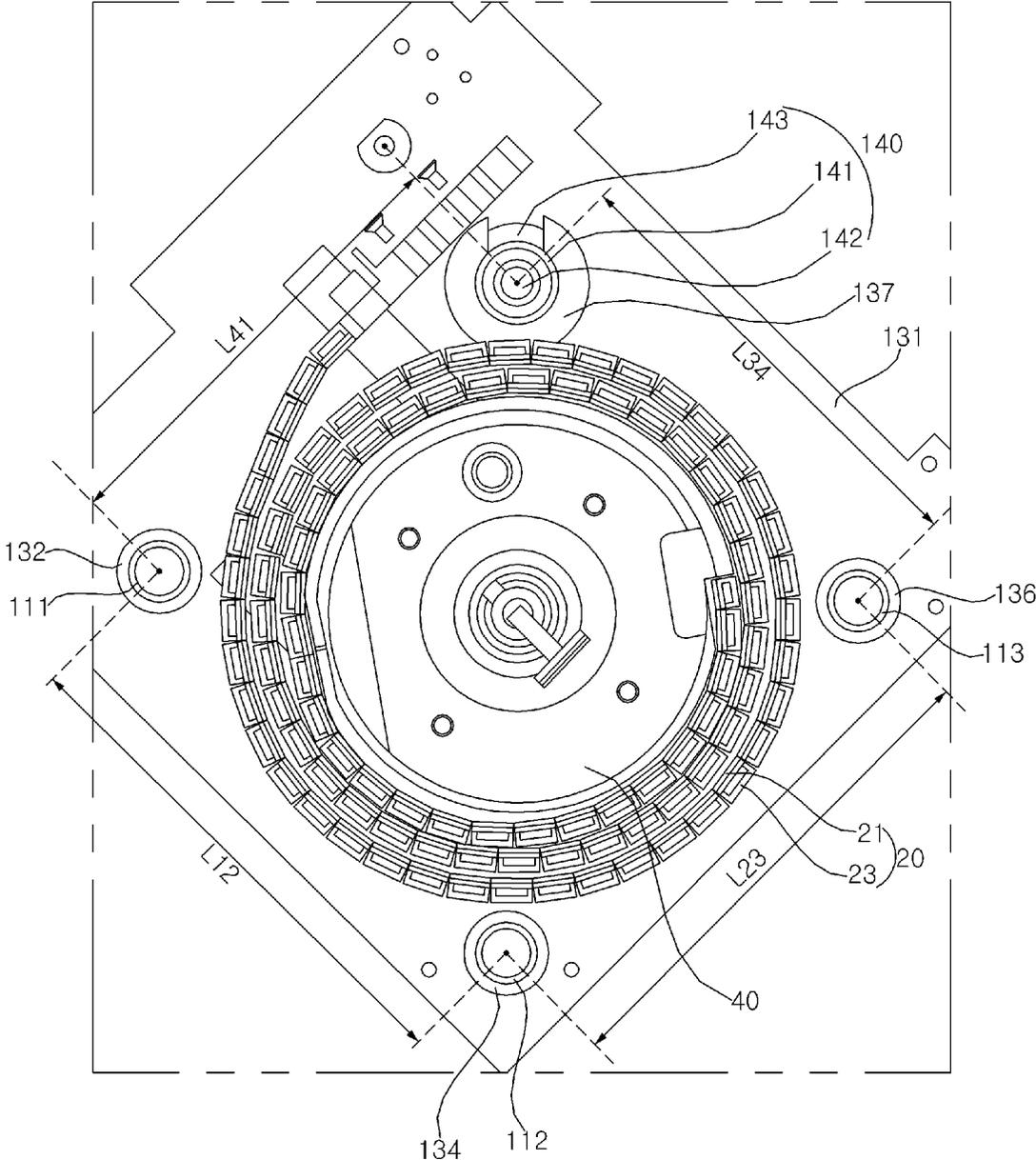


FIG. 21

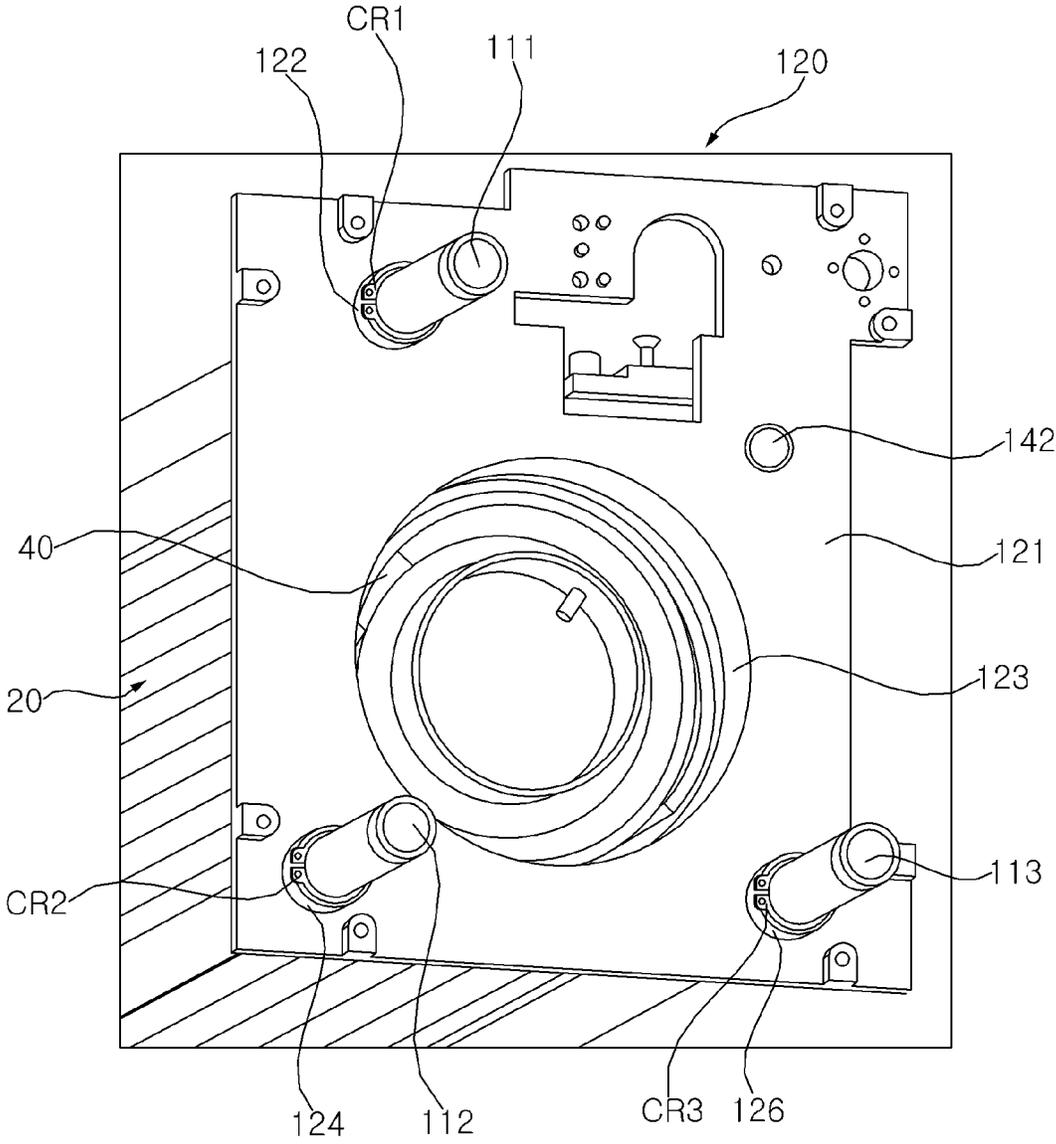


FIG. 22

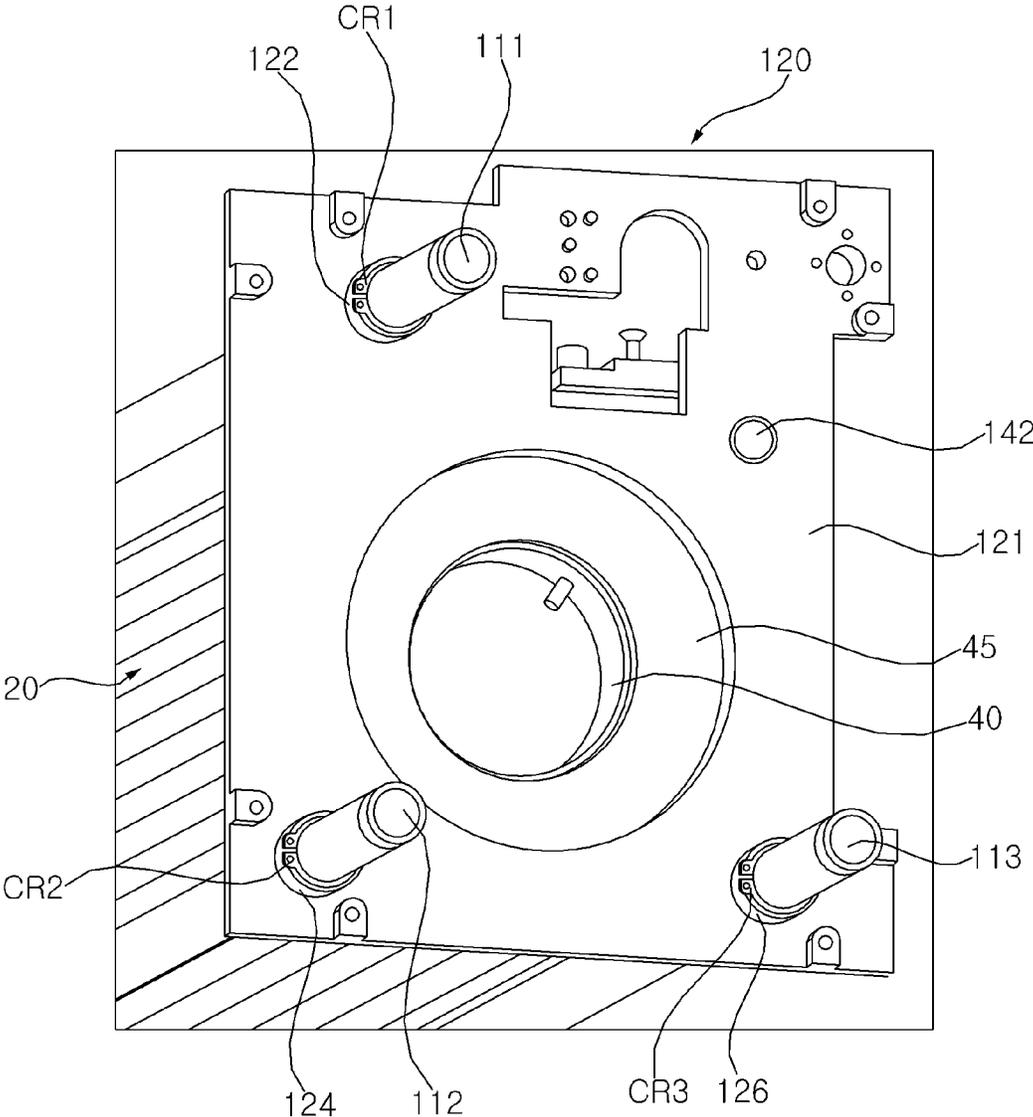


FIG. 23

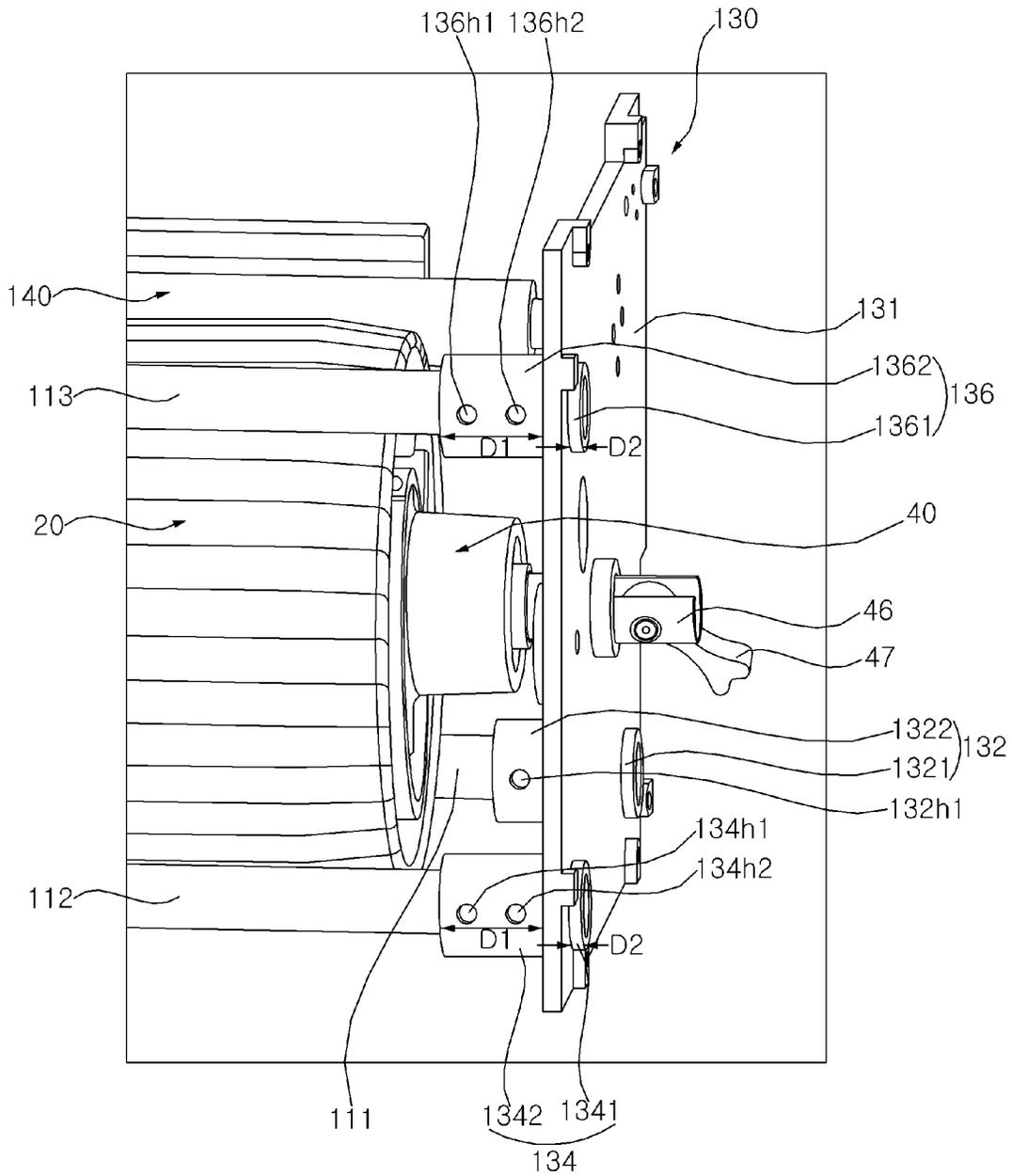


FIG. 24

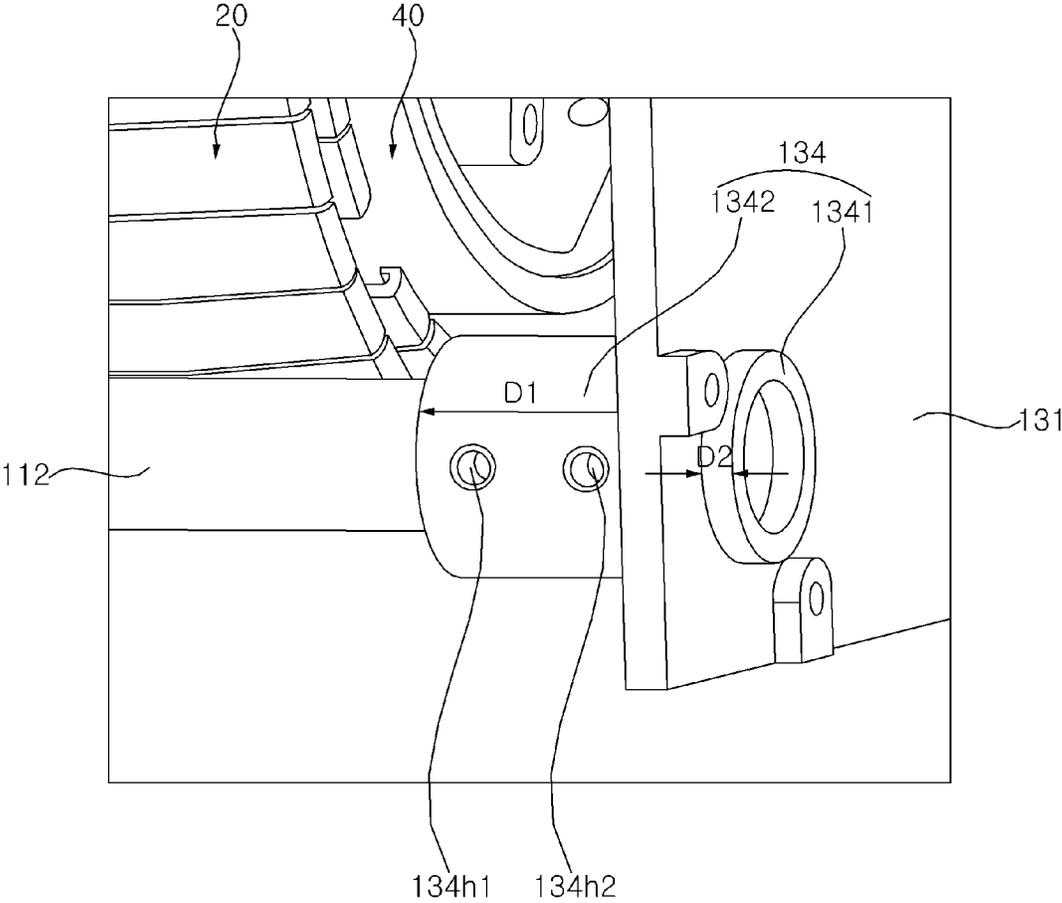


FIG. 25

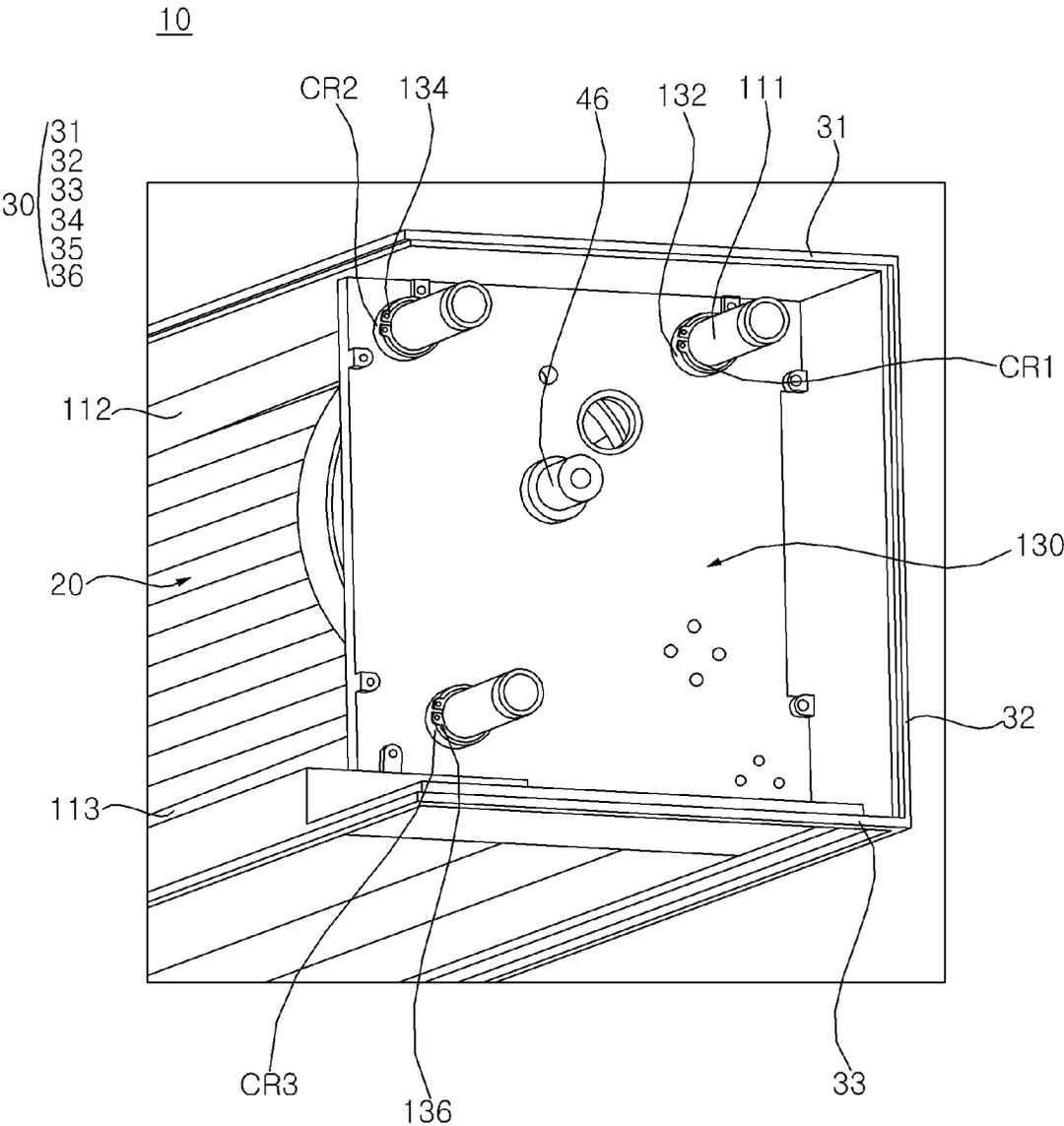


FIG. 26

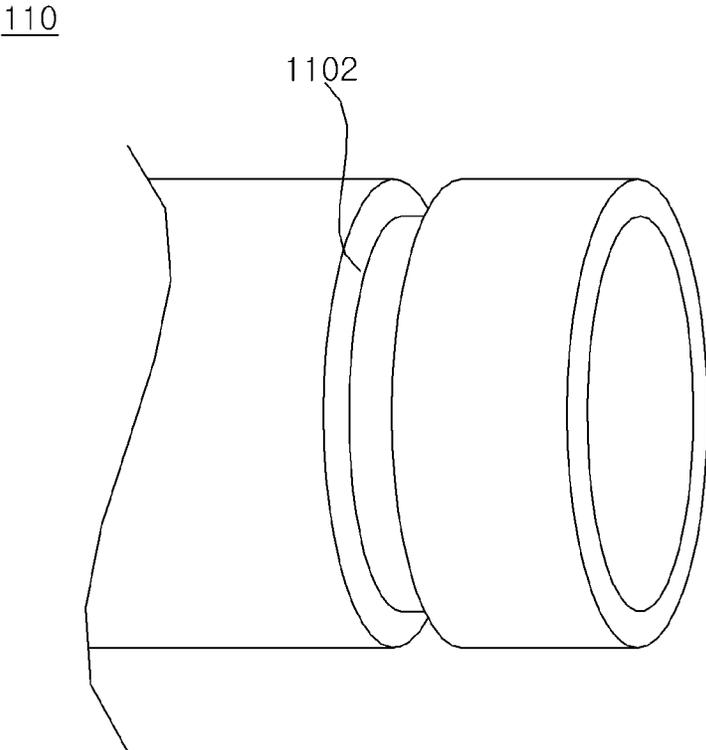


FIG. 27

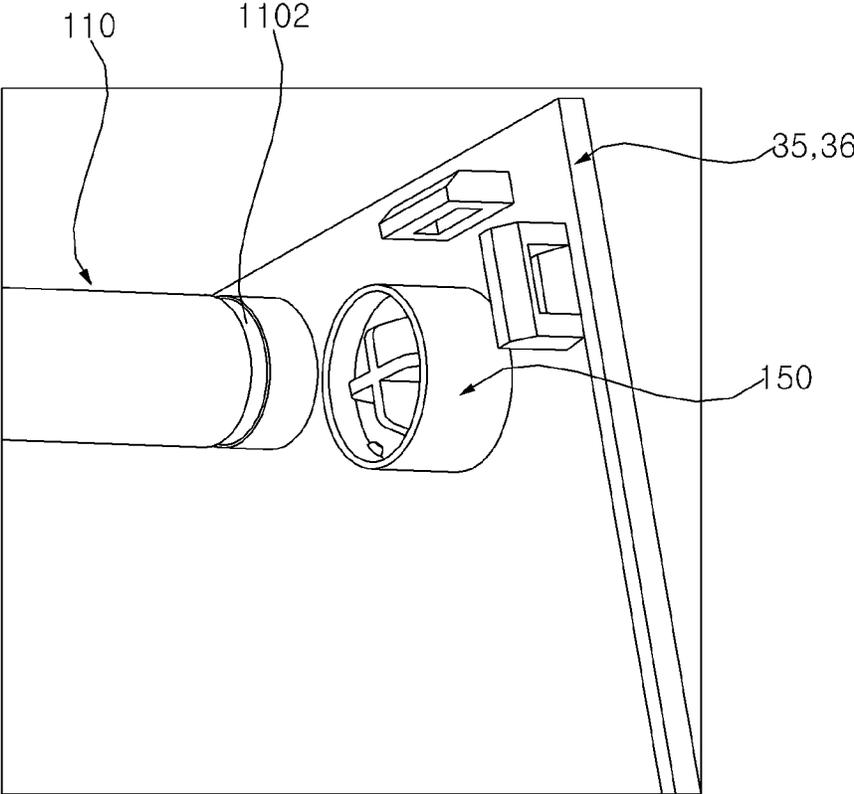


FIG. 28

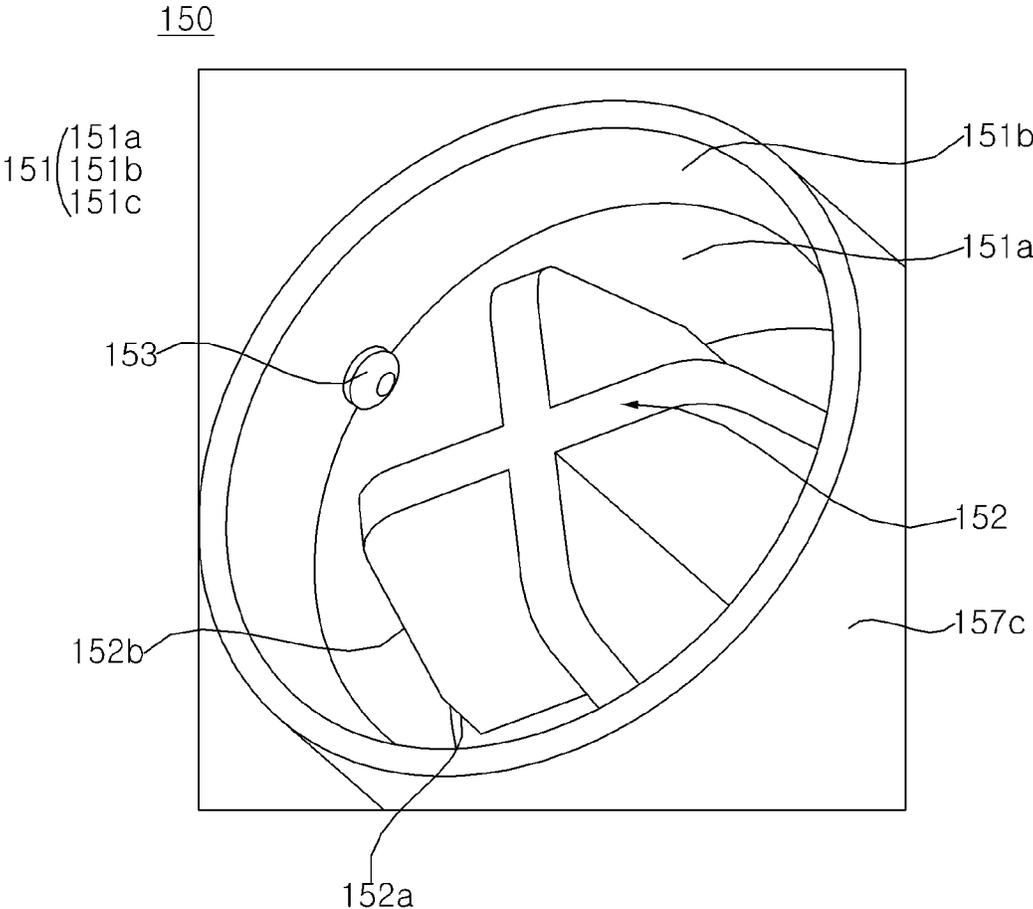


FIG. 29

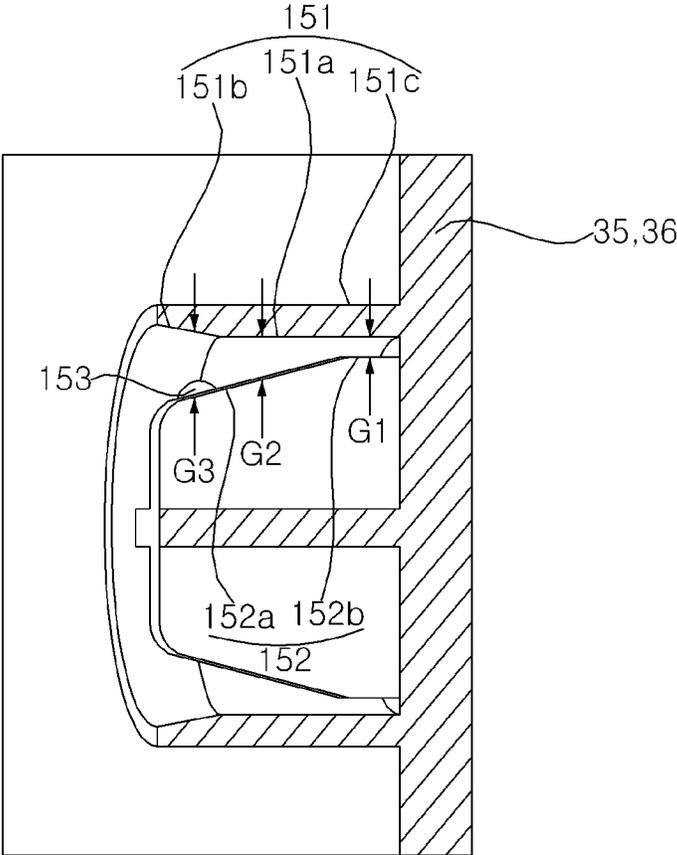


FIG. 30

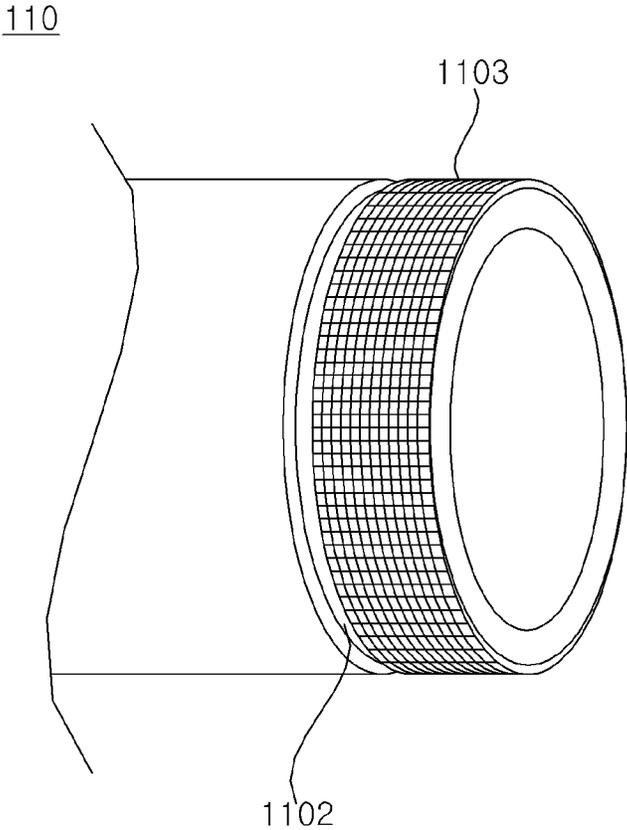


FIG. 31

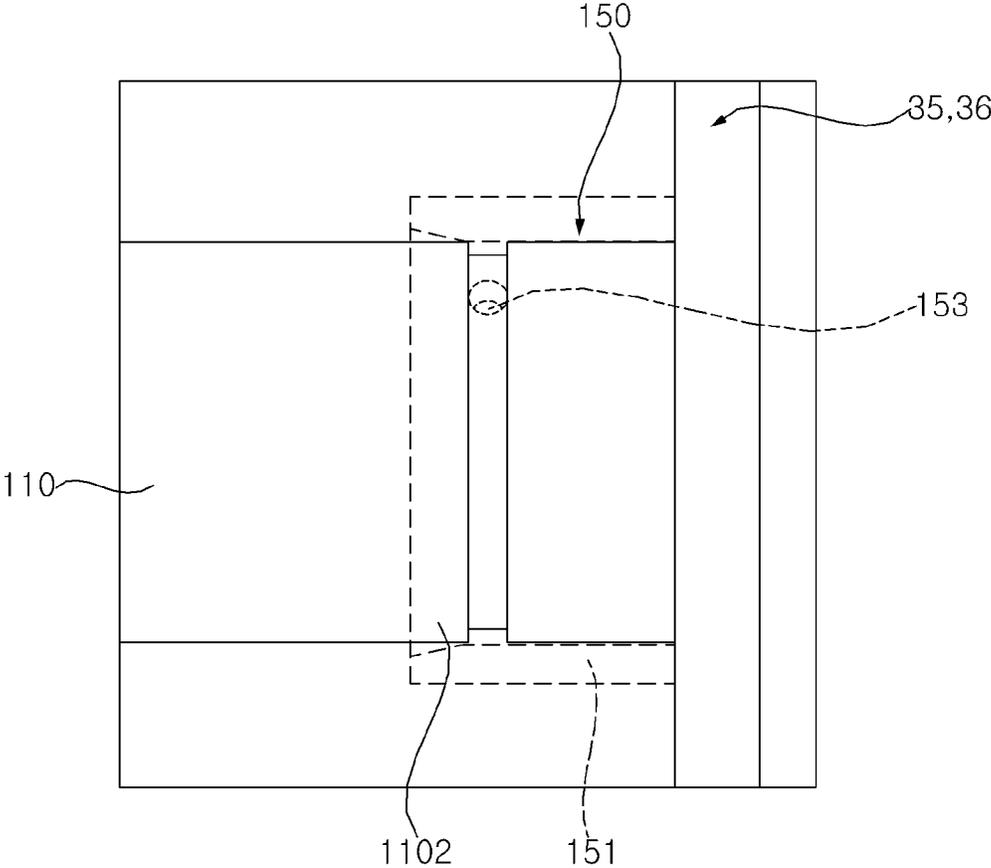


FIG. 32

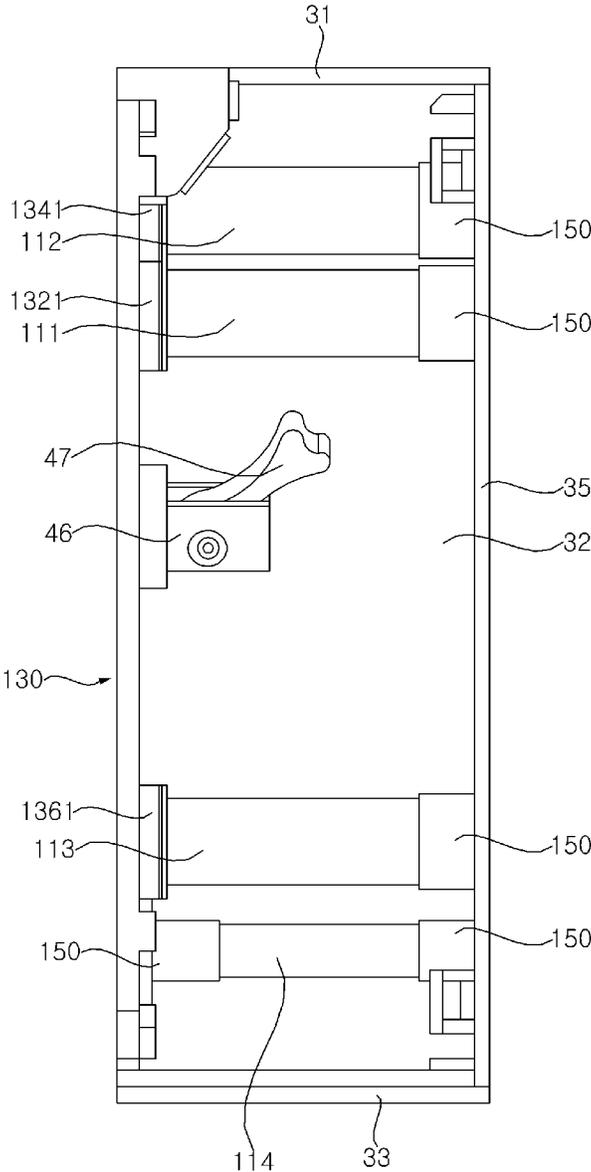


FIG. 33

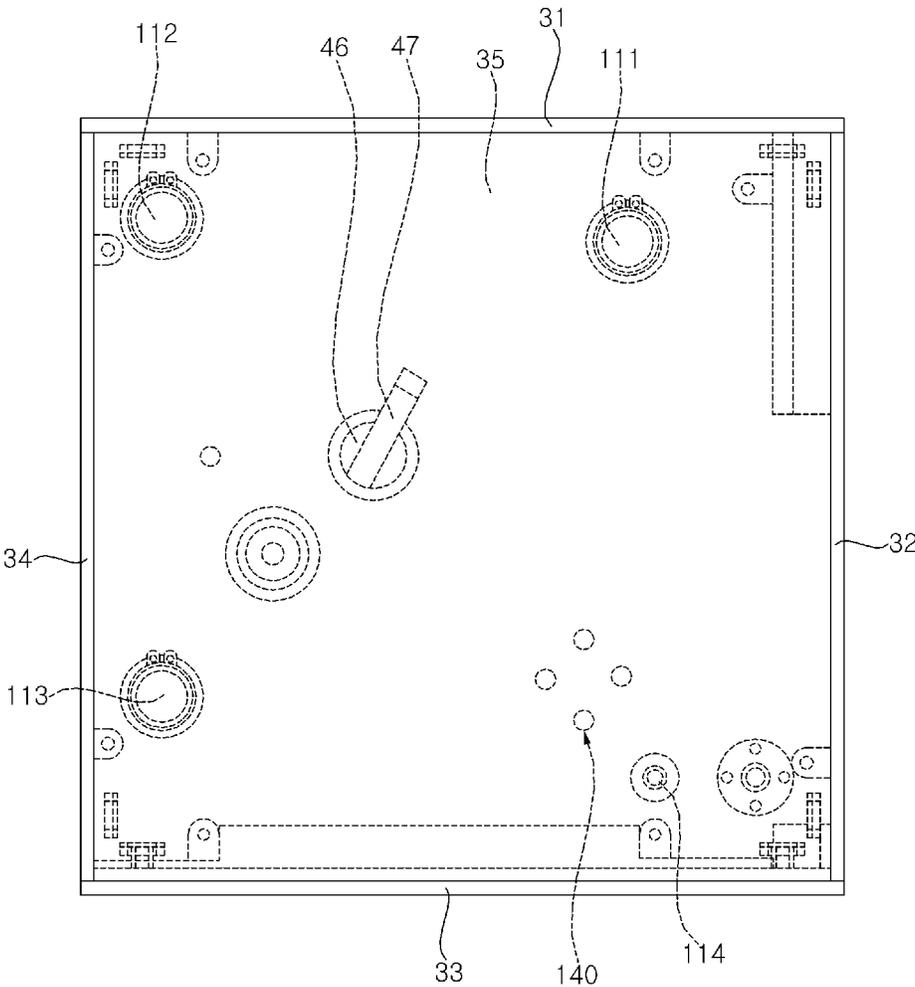


FIG. 34

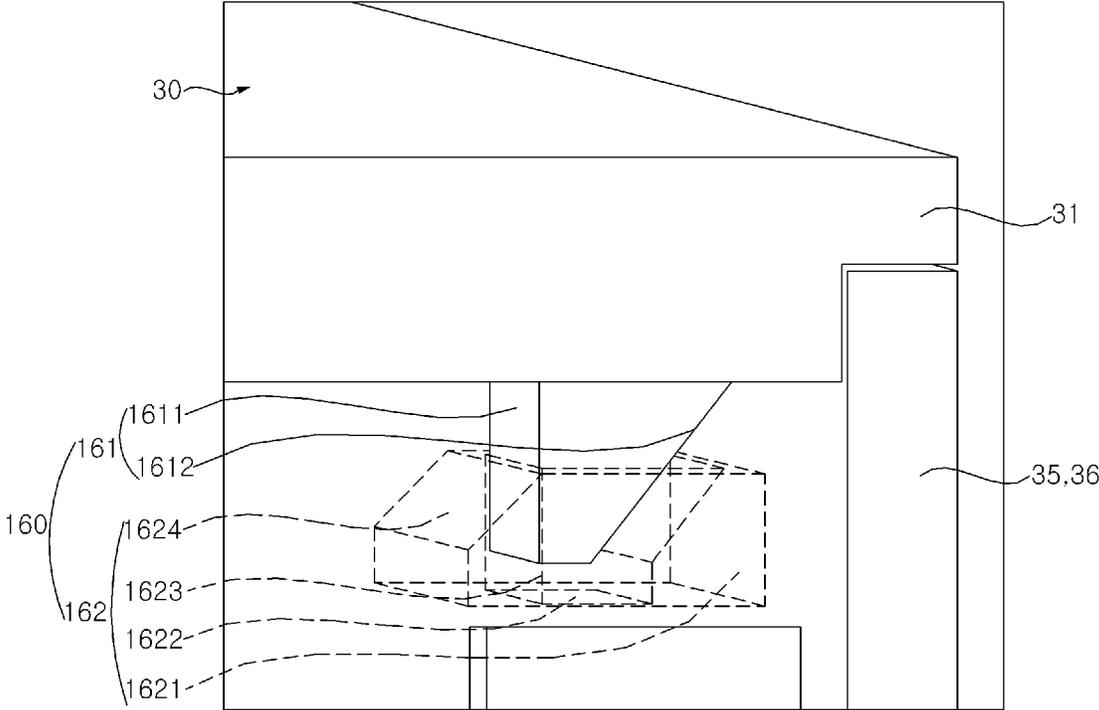


FIG. 36

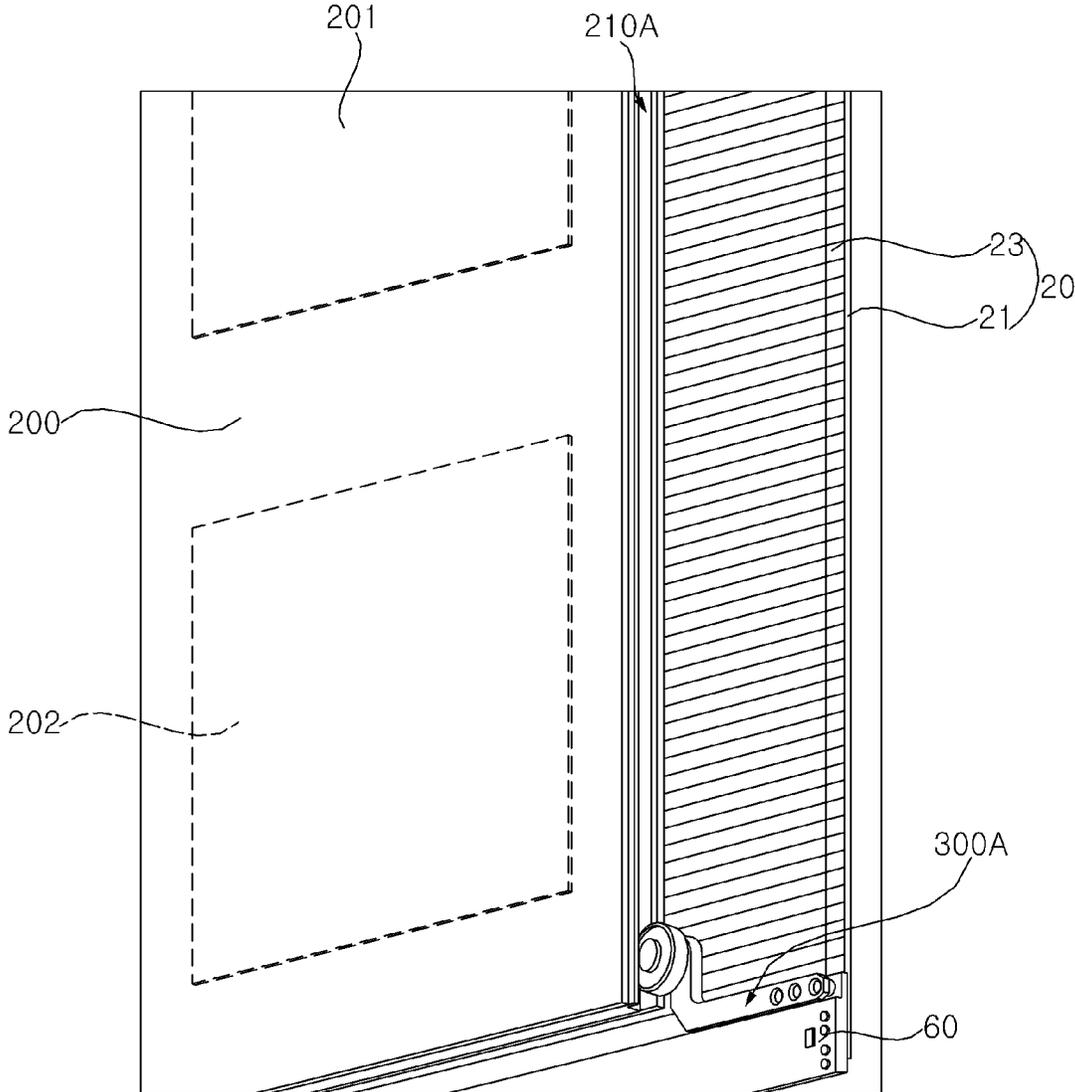


FIG. 37

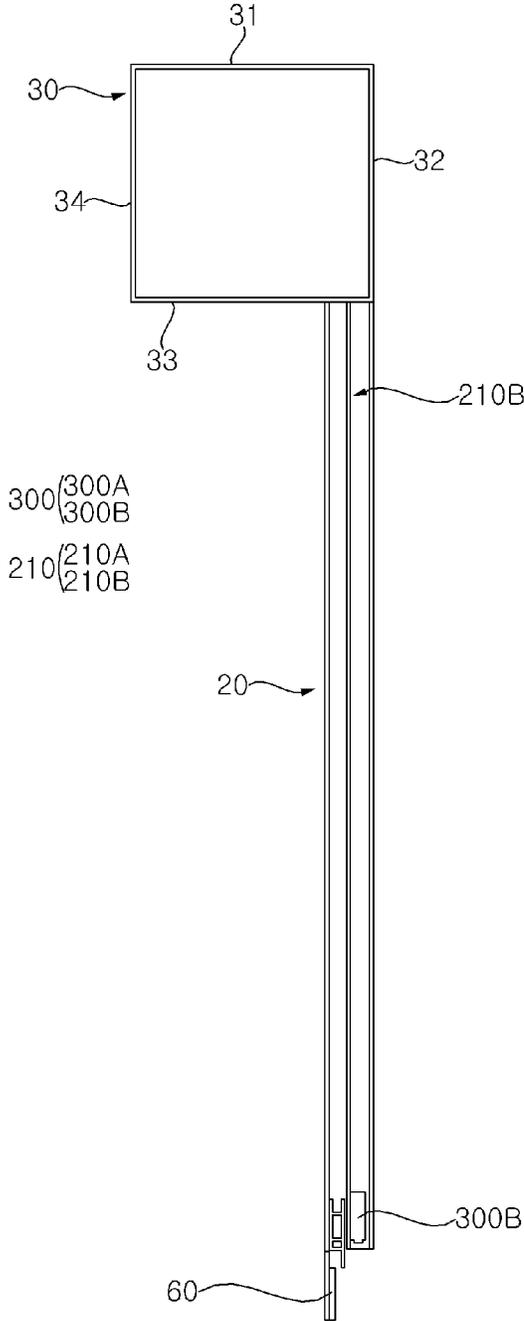


FIG. 38

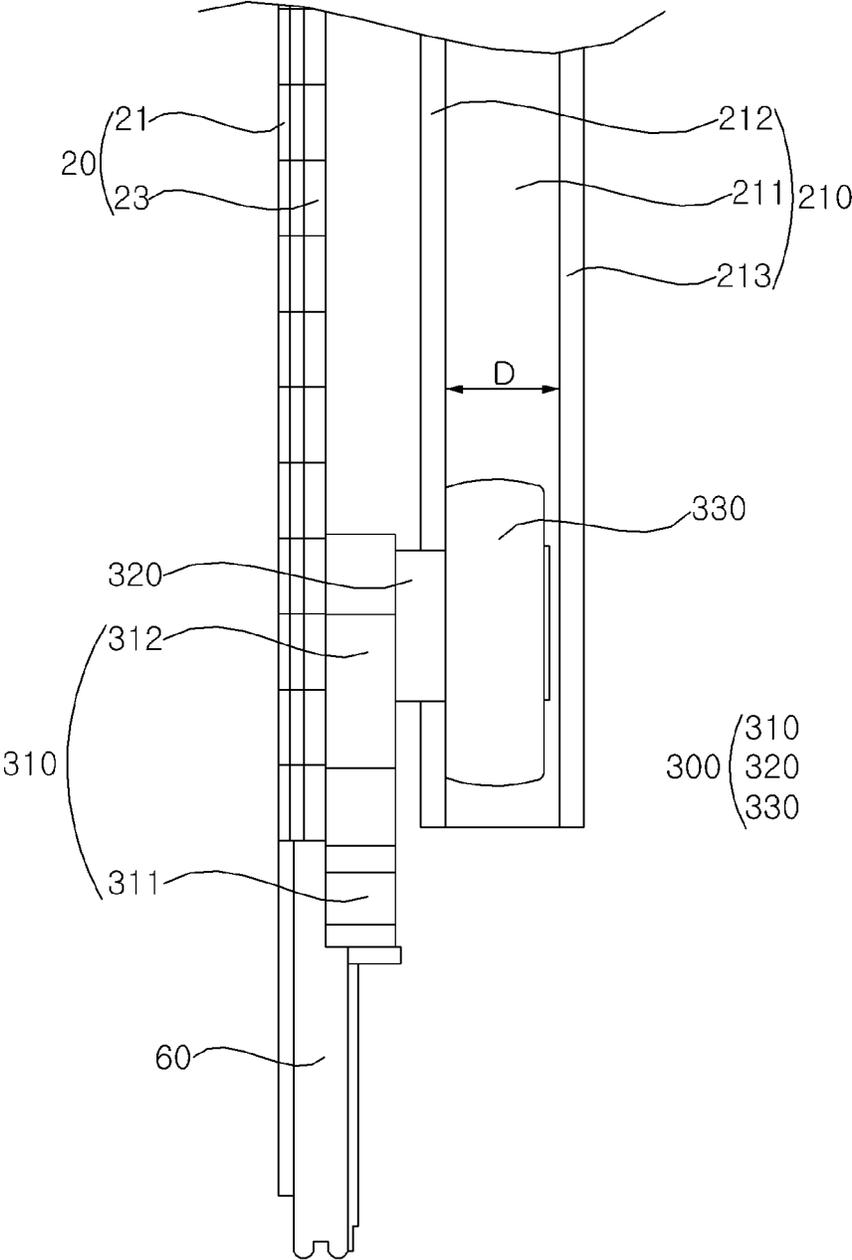


FIG. 39

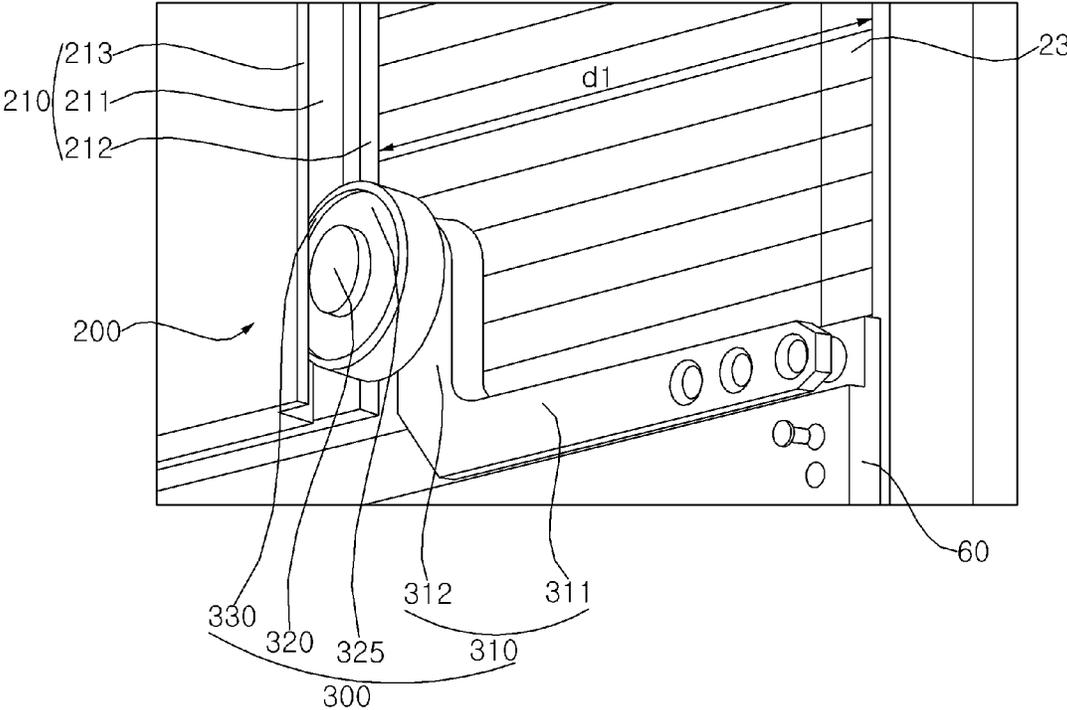
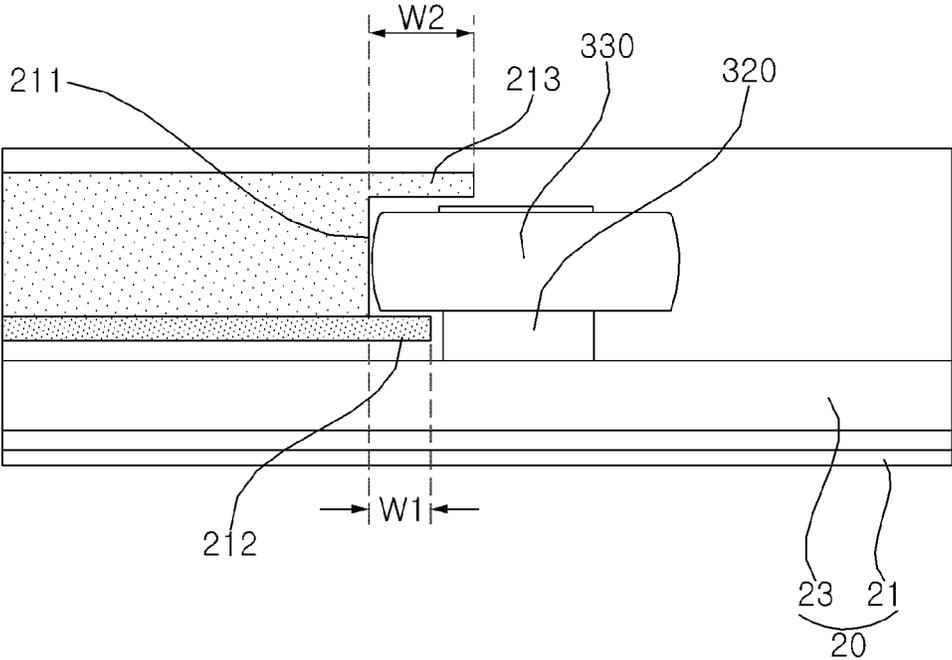


FIG. 40



1

DISPLAY DEVICE**CROSS-REFERENCE TO RELATED APPLICATIONS**

This application is the National Stage filing under 35 U.S.C. 371 of International Application No. PCT/KR2019/018797, filed on Dec. 31, 2019, the contents of which are hereby incorporated by reference herein its entirety.

TECHNICAL FIELD

The present disclosure relates to a display device.

BACKGROUND ART

As the information society has developed, the demand for display device is increasing in various forms, and accordingly, in recent years, various display devices such as a liquid crystal display (LCD), plasma display panel (PDP), electroluminescent display (ELD), vacuum fluorescent display (VFD), and the like have been studied and used.

Among them, a display device using an organic light emitting diode (OLED) has excellent luminance and viewing angle characteristics in comparison with a liquid crystal display device and does not require a backlight unit, thereby being implemented in an ultrathin type.

In addition, a flexible display panel can be bent or wound around a roller. The flexible display panel may be used to implement a display device that unfolds on a roller or winds around the roller. Many studies have been made on a structure for winding a flexible display panel around a roller or unwinding the flexible display panel from the roller.

DISCLOSURE**Technical Problem**

The present disclosure is directed to solve the above and other problems.

Another aspect of the present disclosure is to ensure structural rigidity for preventing sagging of a display device.

Yet another aspect of the present disclosure is to ensure structural rigidity for preventing twisting of a display device.

A further aspect of the present disclosure is to provide a structure for preventing bending of a display panel.

Technical Solution

An embodiment of the present disclosure provides a display device comprising: a flexible display panel; a panel roller which is elongated and on or from which the display panel is wound or unwound; a housing in which the panel roller is accommodated, wherein while the display panel is unwound from the panel roller, the display panel descends below the housing; and a board case which is disposed behind the display panel descending below the housing, and of which the front surface is covered by the display panel while the display panel descends.

Advantageous Effects

A display device according to the present disclosure has the following effects.

2

According to at least one of the embodiments of the present disclosure, it is possible to ensure structural rigidity for preventing sagging of a display device.

According to at least one of the embodiments of the present disclosure, it is possible to ensure structural rigidity for preventing twisting of a display device.

According to at least one of the embodiments of the present disclosure, it is possible to provide a structure for preventing bending of a display panel.

Additional scope of applicability of the present disclosure will become apparent from the following detailed description. However, various changes and modifications within the spirit and scope of the present disclosure may be clearly understood by those skilled in the art, and thus, it should be understood that specific embodiments, such as the detailed description and preferred embodiments of the present disclosure, are given only by way of illustration.

DESCRIPTION OF DRAWINGS

FIGS. 1 to 40 are diagrams illustrating examples of a display device according to embodiments of the present disclosure.

MODE FOR DISCLOSURE

Hereinafter, embodiments of the present disclosure will be described in detail with reference to the accompanying drawings, however, the same or similar elements are denoted by the same reference numerals regardless of the reference numerals, and redundant description thereof will be omitted.

The suffixes "module" and "part" for components used in the following description are given or mixed in consideration of ease of specification, and do not have their own meaning or role.

Further, in describing the embodiments disclosed in this specification, when it is determined that the detailed description of the related art is likely to blur the gist of the embodiment disclosed in this specification, a detailed description thereof will be omitted. Also, the accompanying drawings are only for the purpose of easily understanding the embodiments disclosed in the present disclosure, and the technical idea disclosed in the present disclosure is not limited by the accompanying drawings, it should be understood that the present disclosure include all modifications, equivalents and substitutes included within the spirit and technical scope of the present disclosure.

The terms first, second, etc. may be used to describe various components, but the components are not limited by such terms. The terms are used only for the purpose of distinguishing one component from other components.

When an arbitrary component is described as "being connected to" or "being linked to" another component, this should be understood to mean that still another component (s) may exist between them, although the arbitrary component may be directly connected to, or linked to, the second component. In contrast, when an arbitrary component is described as "being directly connected to" or "being directly linked to" another component, this should be understood to mean that no component exists between them.

A singular expression can include a plural expression as long as it does not have an apparently different meaning in context.

In the following description, even if an embodiment is described with reference to a specific figure, if necessary, a reference numeral not shown in the specific figure may be

3

referred to, and a reference numeral not shown in the specific figure is used when the reference numeral is shown in the other figures.

Referring to FIG. 1, a display device 10 may include a display unit 20 and a housing 30. The housing 30 may have an internal space. At least a portion of the display unit 20 may be located inside the housing 30. At least a portion of the display unit 20 may be located outside the housing 30. The display unit 20 may display a screen.

The direction parallel to the longitudinal direction of the housing 30 may be referred to as a first direction DR1, a leftward direction, or a rightward direction. The direction in which the display unit 20 displays a screen may be referred to as a forward direction or the front. The direction opposite the direction in which the display unit 20 displays an image may be referred to as a rearward direction or the rear. The direction parallel to the height direction of the display device 10 may be referred to as a second direction DR2, an upward direction, or a downward direction.

The third direction DR3 may be a direction perpendicular to the first direction DR1 and/or the second direction DR2. The first direction DR1 and the second direction DR2 may be collectively referred to as a horizontal direction. In addition, the third direction DR3 may be referred to as a vertical direction. A leftward-rightward direction LR may be parallel to the first direction DR1, and an upward-downward direction UD may be parallel to the second direction DR2.

Referring to FIG. 2, the display unit 20 may be entirely located inside the housing 30. At least a portion of the display unit 20 may be located outside the housing 30. The degree to which the display unit 20 is exposed to the outside of the housing 30 may be adjusted as necessary.

Referring to FIG. 3, the display unit 20 may include a display panel 21 and a plate 23. The display panel 21 may be flexible. For example, the display panel 21 may be an organic light emitting display (OLED).

The display panel 21 may have a front surface for displaying an image. The display panel 21 may have a rear surface facing the front surface. The front surface of the display panel 21 may be covered with a light transmissive material. For example, the light transmissive material may be a synthetic resin or film.

The plate 23 may be coupled, fastened, or attached to the rear surface of the display panel 21. The plate 23 may include a metal material. The plate 23 may be referred to as a module cover 23, a cover 23, a display panel cover 23, a panel cover 23, or an apron 23.

Referring to FIG. 4, the plate 23 may include a plurality of segments 23c. A magnet 24 may be located inside a recess 26 of the segment 23c. The recess 26 may be located on a surface of the segment facing the display panel 21. The recess 26 may be located in the front surface of each segment 23c. Since the magnet 24 is received inside the recess 26, the magnet 24 may not protrude from the segment 23c. The display panel 21 may be flat without being wrinkled even when it is in contact with the segment 23c.

Referring to FIG. 5, a bead 27 may be formed on an upper surface of a segment 23b. The bead 27 may have a shape recessed to the inside of the segment 23b. For example, the bead 27 may be formed by pressing the segment 23b. A plurality of beads 27 may be formed on the segment 23b. The plurality of beads 27 may be spaced apart from each other. The beads 27 can improve the rigidity of the segment 23b. For example, the bead 27 can prevent the shape of the segment 23b from being deformed by an external impact. The segment 23b may be fixed to the rear of the display pane

4

21 by an adhesive member 22. For example, the adhesive member 22 may be double-sided tape.

Referring to FIG. 6, a source PCB 21b may be positioned on the lower side of the module cover 23. In the case of roll-down or roll-up, the position of the source PCB 21b may change depending on the movement of the module cover 23. An FFC cable 21a may be positioned in the center of the module cover 23 with respect to the first direction. The FFC cable 21a may be positioned on opposite ends of the module cover 23 with respect to the first direction.

Referring to FIG. 7, a segment 23d may include a recess 28 that is recessed inwardly of the segment 23d. The recess 28 may form a space between the display panel 21 and the module cover 23. The FFC cable 21a may be received in the space formed by the recess 28. The recess 28 can improve the rigidity of the segment 23d. The bead 27 may be positioned on the segment 23d except the part where the recess 28 is positioned. The position of the recess 28 may not overlap the position of the bead 27 in order to prevent a reduction in rigidity of the segment 23d.

Referring to FIG. 8, a segment 23e may have a through portion 29 positioned in the center with respect to the first direction. The through portion 29 may pass through a central portion of the segment 23e in the second direction. Namely, the through portion 29 may be a hole positioned in the segment 23e. The through portion 29 may be a portion in which the FFC cable 21a is positioned. Because the through portion 29 is formed inside the segment 23d, the thickness of the segment 23e may be reduced compared to when the FFC cable 21a is positioned in the recess 28 (see FIG. 7). The bead 27 may be positioned on the segment 23e except the part where the through portion 29 is positioned. The position of the through portion 29 may not overlap the position of the bead 27 in order to prevent a reduction in rigidity of the segment 23e.

Referring to FIG. 9, a top case 60 may cover the source PCB 21b and the upper bar 50 as well as the display panel 21 and the module cover 23. One surface of the upper bar 50 may be coupled to the rear surface of the module cover 23, and the other surface of the upper bar 50 may be coupled to the source PCB 21b. The upper bar 50 may be fixed to the module cover 23 and may support the source PCB 21b.

A lower end of the FFC cable 21a may be connected to a timing controller board 41 (see FIG. 10) inside a panel roller 40 (see FIG. 10). The FFC cable 21a, together with the display unit 20, may be wound around or unwound from the panel roller 40.

A portion of the FFC cable 21a may be positioned between the display panel 21 and the module cover 23. The portion of the FFC cable 21a that is positioned between the display panel 21 and the module cover 23 may be referred to as a first portion 21a1. The first portion 21a1 may be positioned in the recess 28 in which the plurality of segments 23d is formed. Alternatively, the first portion 21a1 may be received in the recess 28 in which the plurality of segments 23d is formed.

A portion of the FFC cable 21a may pass through a segment 23f. The portion of the FFC cable 21a that passes through the segment 23f may be referred to as a second portion 21a2. The segment 23f may include a first hole 23fh1 formed at a front surface and a second hole 23fh2 formed at a rear surface. The first hole 23fh1 and the second hole 23fh2 may be connected to each other to form one hole 23fh. The hole 23fh may pass through the segment 23f in the third direction. The second portion 21a2 may pass through the hole 23fh. The hole 23fh may be referred to as a connection hole 23fh.

An upper end of the FFC cable **21a** may be electrically connected to the source PCB **21b**. A portion of the FFC cable **21a** may be positioned on the rear surface of the module cover **23**. The portion of the FFC cable **21a** that is positioned on the rear surface of the module cover **23** may be referred to as a third portion **21a3**. The third portion **21a3** may be electrically connected to the source PCB **21b**.

The third portion **21a3** may be covered by the top case **60**. Hence, the third portion **21a3** may not be exposed to the outside.

Referring to FIG. **10**, the FFC cable **21a** may be connected to the timing controller board **41** mounted on the panel roller **40**. A through hole **42** may be formed on the panel roller **40**, and the FFC cable **21a** may be connected to one side of the timing controller board **41** through the through hole **42**.

The through hole **42** may be positioned on one side of the panel roller **40** and may pass through an outer circumferential portion of the panel roller **40**. The FFC cable **21a** may be connected to one side of the timing controller board **41** through the through hole **42**.

Even if the FFC cable **21a** is positioned on the outer circumference of the panel roller **40**, the connection between the FFC cable **21a** and the timing controller board **41** can be maintained by the through hole **42**. Hence, the FFC cable **21a** rotates together with the panel roller **40** and may not be twisted.

A portion of the FFC cable **21a** may be wound around the panel roller **40**. The portion of the FFC cable **21a** wound around the panel roller **40** may be referred to as a fourth portion **23a4**. The fourth portion **23a4** may come into contact with an outer circumferential surface of the panel roller **40**.

A portion of the FFC cable **21a** may pass through the through hole **42**. The portion of the FFC cable **21a** that passes through the through hole **42** may be referred to as a fifth portion **23a5**.

The lower end of the FFC cable **21a** may be electrically connected to the timing controller board **41**. A portion of the FFC cable **21a** may be positioned inside the panel roller **40**. The portion of the FFC cable **21a** that is positioned inside the panel roller **40** may be referred to as a sixth portion **23a6**. The sixth portion **23a6** may be electrically connected to the timing controller board **41**.

Referring to FIG. **11**, the display panel **21** may be connected to the roller **40**. The display panel **21** may be wound around or unwound from the roller **40**. The display panel **21** may be electrically connected to a plurality of source PCBs **21b**. The plurality of source PCBs **21b** may be spaced apart from each other.

A source chip on film (COF) **21m** may connect the display panel **21** and the source PCBs **21b**. The source COF **21m** may be located at the lower side of the display panel **21**. The roller **40** may include a first part **43** and a second part **44**. The first part **43** and the second part **44** may be fastened by a screw. A timing controller board **41** may be mounted in the roller **40**.

The source PCBs **21b** may be electrically connected to the timing controller board **41**. The timing controller board **41** may send digital video data and timing control signals to the source PCBs **21b**.

A cable **21p** may electrically connect the source PCBs **21b** and the timing controller board **41**. For example, the cable **21p** may be a flexible flat cable (FFC). The cable **21p** may pass through a hole **21n**. The hole **21n** may be formed in a seating portion **45** or the first part **43**. The cable **21p** may be located between the display panel **21** and the second part **44**.

The seating portion **45** may be formed in an outer circumference of the first part **43**. The seating portion **45** may be formed by stepping a portion of the outer circumference of the first part **43**. The seating portion **45** may form a space **B**. When the display unit **20** is wound around the roller **40**, the source PCBs **21b** may be received in the seating portion **45**. Since the source PCBs **21b** are received in the seating portion **45**, they may not be warped or bent, and their durability may be improved.

Referring to FIGS. **12** and **13**, a pipe **110** may extend longitudinally in leftward and rightward directions. A plurality of pipes **110** may be provided. The plurality of pipes **110** may include a first pipe **111**, a second pipe **112**, and a third pipe **113**. The plurality of pipes **110** may be parallel to each other. For example, the pipes **110** may be a hollow cylinder. For another example, the pipes **110** may be a cylindrical bar.

The pipes **110** may be coupled to the frames **120** and **130** as they are inserted into frames **120** and **130**. The frames **120** and **130** may have a first frame **120** and a second frame **130**. The first frame **120** may be positioned contiguous to one end of the pipes **110**, and the second frame **130** may be positioned contiguous to the other end of the pipes **110**. The first frame **120** may face the second frame **130**.

For example, the frames **120** and **130** may be a rectangular plate. The first pipe **111** may be inserted into the frames **120** and **130**, contiguous to a first corner C1 of the first frame **120** and the second frame **130**. The second pipe **112** may be inserted into the frames **120** and **130**, contiguous to a second corner C2 of the first frame **120** and the second frame **130**. The third pipe **113** may be inserted into the frames **120** and **130**, contiguous to a third corner C3 of the first frame **120** and the second frame **130**.

A central opening **123** may be formed in a plate **121** of the first frame **120**. The central opening **123** may be a circle that is formed through the plate **121** of the first frame **120**. The first pipe **111**, the second pipe **112**, and the third pipe **113** may be disposed in a triangular shape with respect to the central opening **123**.

Referring to FIG. **13**, couplings **122**, **124**, **126**, **132**, **134**, and **136** may be formed on the plates **121** and **131**. The first frame **120** may include an eleventh coupling **122**, a twelfth coupling **124**, and a thirteenth coupling **126** that are formed on the plate **121**. The second frame **130** may include a twenty-first coupling **132**, a twenty-second coupling **134**, and a twenty-third coupling **136** that are formed on the plate **131**. The first pipe **111** may be inserted into the eleventh coupling **122** and the twenty-first coupling **132**. The second pipe **112** may be inserted into the twelfth coupling **124** and the twenty-second coupling **134**. The third pipe **113** may be inserted into the thirteenth coupling **126** and the twenty-third coupling **136**. The couplings **122**, **124**, **126**, **132**, **134**, and **136** may be referred to as intermediate couplers **122**, **124**, **126**, **132**, **134**, and **136**.

Referring to FIGS. **14** and **15**, the coupling **136** may have the shape of a cylinder that is formed through the plate **131**. The coupling **136** may be fixed to the plate **131**, or may be formed integrally with the plate **131**. The coupling **136** may have an outer side **1361** and an inner side **1362** with respect to the plate **131**. The distance D2 of the outer side **1361** may be smaller than the distance D1 of the inner side **1362**. A fastening hole **136h** may be formed in the inner side **1362**. As a screw is fastened to the fastening hole **136h**, the pipe **113** may be fixed to the frame **130**.

A first neck **1131** may be contiguous to the outer side **1361** of the coupling **136** and form an engraved ring on an outer surface of the pipe **113** as it is recessed inwardly of the pipe

113. A second neck **1132** may be contiguous to a distal end of the pipe **113** and form an engraved ring on the outer surface of the pipe **113** as it is recessed inwardly of the pipe **113**, spaced apart from the distal end of the pipe **113**. As a coupling ring **CR3** is fastened to the first neck **1131**, the pipe **113** may be firmly fixed to the frame **130**. For example, the coupling ring **CR3** may be an E-ring.

Referring to FIGS. **16** to **19**, the display unit **20** wound around the panel roller **40** may be inserted between the first pipe **111**, the second pipe **112**, the third pipe **113**, the first frame **120**, and/or the second frame **130**. The panel roller **40** may be disposed parallel to the first pipe **111**, the second pipe **112**, or the third pipe **113**.

As the panel roller **40** and the display unit **20** are positioned between the pipes **110** and the frames **120** and **130**, the guide roller **140** may be coupled to the frames **120** and **130**. The guide roller **140** may have a shaft **142**, a roller **141**, and a fixed plate **143**.

A support portion **137** may be formed on the plate **131**. The support portion **137** may support the shaft **142** of the guide roller **140**. The shaft **142** may be fixed to the support portion **137**, and the roller **140** may rotate on the shaft **142**. The support portion **137** may be formed on an inner side of the plate **131**.

The support portion **137** may include a body **1371**, a shaft groove **1372**, and a plate insertion groove **1373**. The body **1371** may have the shape of a cylinder that protrudes from an inner surface of the plate **131**. The shaft groove **1372** may be depressed inward of the body **1371** from the outer periphery of the body **1371**. The plate insertion groove **1373** may be depressed inward of the body **1371** from the outer periphery of the body **1371**, between the shaft groove **1372** and the plate **131**. The groove width **W2** of the plate insertion groove **1373** may be larger than the groove width **W1** of the shaft groove **1372**.

In other words, the shaft groove **1372** may have a groove width **W1** corresponding to the diameter of the shaft **142**, and the plate insertion groove **1373** may have a groove width **W2** corresponding to the diameter of the fixed plate **143**. As the shaft **142** of the guide roller **140** is inserted into the shaft groove **1372**, and the fixed plate **143** of the guide roller **140** is inserted into the plate insertion groove **1373** of the support portion **137**, the guide roller **140** may be supported by the support portion **137**.

The fixed plate **143** may be fixed to the frame **130** by a fastening member (e.g., a screw) fastened to fastening holes **137h** penetrating the frame **130**. Referring to FIG. **21**, the shaft **142** may be inserted into and fixed to the frame **120**.

Referring to FIG. **20**, the distance **L12** between the first pipe **111** and the second pipe **112** may be larger than the distance **L23** between the second pipe **112** and the third pipe **113**. The distance **L12** between the first pipe **111** and the second pipe **112** may be larger than the distance **L34** between the third pipe **113** and the guide roller **130**. The distance **L12** between the first pipe **111** and the second pipe **112** may be larger than the distance **L41** between the first pipe **111** and the guide roller **140**. The distance **L23** between the second pipe **112** and the third pipe **113** may be larger than the distance **L41** between the first pipe **111** and the guide roller **140**. The distance **L23** between the second pipe **112** and the third pipe **113** may be larger than the distance **L34** between the third pipe **113** and the guide roller **140**. The distance **L34** between the third pipe **113** and the guide roller **140** may be larger than the distance **L41** between the first pipe **111** and the guide roller **140**. Consequently, the rigidity of the display device against torsion as well as sagging may be improved.

Referring to FIGS. **21** to **24**, one end of the panel roller **40** may be positioned contiguous to the central opening **123** of the first frame **120**. A rotating shaft of the panel roller **40** may be aligned in the center of the central opening **123** of the first frame **120**. A bearing **45** may be mounted to the central opening **123** of the first frame **120**. For example, the bearing **45** may be a ring bearing **45**. One end of the panel roller **40** may be inserted or press-fitted into the bearing **45**. The other end of the panel roller **40** may be rotatably coupled to the second frame **130**. The panel roller **40** may have a rotating shaft **46**, and the rotating shaft **46** may penetrate the first frame **130** and be installed on the second frame **130**. The rotating shaft **46** may be connected to a lever **47**, and manually rotate the panel roller **40** through the lever **47**.

The coupling **136** may have the shape of a cylinder that is formed through the plate **131**. The coupling **136** may be fixed to the plate **131**, or may be formed integrally with the plate **131**. The coupling **136** may have an outer side **1361** and an inner side **1362** with respect to the plate **131**. The distance **D2** of the outer side **1361** may be smaller than the distance **D1** of the inner side **1362**. For example, the distance **D1** of the inner side **1362** may be five times as large as or larger than the distance **d2** of the outer side **1361**.

The pipes **112** and **113** may penetrate through inner sides **1342** and **1362** of the couplings **134** and **136** and be press-fitted to outer sides **1341** and **1361** thereof. The pipes **112** and **113** may not penetrate through the couplings **134** and **136** of the pipes **112** and **113**. The outer sides **1341** and **1361** of the couplings **134** and **136** may cover distal ends of the pipes **112** and **113**. A first fastening hole **136h1** and a second fastening hole **136h2** may be formed in the inner side **1362**. As screws are fastened to the first fastening hole **136h1** and the second fastening hole **136h2**, the pipe **113** may be firmly fixed to the frame **130**.

Referring to FIG. **25**, the housing **30** may include an upper plate **31**, a lower plate **33**, a front plate **34** (see FIG. **1**), and a rear plate **32**. The upper plate **31** may be coupled to the first frame **120** and the second frame **130** while covering the first pipe **111** and the second pipe **112**. The front plate **34** may be coupled to the first frame **120** and the second frame **130** while covering the second pipe **112** and the third pipe **113**. The rear plate **32** may be coupled to the first frame **120** and the second frame **130** while covering the first pipe **111** and the guide roller **140**. The lower plate **33** may be coupled to the first frame **120** and the second frame **130** while covering the third frame **113** and the guide roller **140**. The lower plate **33** may be a door.

Referring to FIGS. **26** and **27**, the pipe **110** may have a neck **1102** that is positioned contiguous to the distal end thereof and formed on the outer periphery of the pipe **110**. The neck **1102** may be the second neck **1132** explained with reference to FIGS. **14** and **15**. A description of the pipe **110** may be applicable to the first pipe **111**, the second pipe **112**, and the third pipe **113** described above.

The pipe **110** may be coupled to side covers **35** and **36**. The coupling **150** may be formed on an inner side of the side covers **35** and **36**. The pipe **110** may be inserted into or press-fitted to the coupling **150**. The coupling **150** may be referred to as an end-coupler **150**.

Referring to FIGS. **28** and **29**, the coupling **150** may have an outer cylinder **151** and an inner insert **152**. The outer cylinder **151** may have the shape of a hollow cylinder. The outer cylinder **151** may have an outer surface **151c**, a first inner surface **151a**, and a second inner surface **151b**. The first inner surface **151a** may be parallel to the outer surface **151c**. The second inner surface **151b** may extend with a

slope from the first inner surface **151a** to the distal end of the outer cylinder **151**. The diameter of the second inner surface **151b** may gradually increase from the diameter of the first inner surface **151a** to the diameter of the outer surface **151c**. The second inner surface **151b** may be referred to as a guide surface **151b**, and the first inner surface **151a** may be referred to as a press-fitting surface **151a**. A protrusion **153** may be formed inside the outer cylinder **151**. For example, the protrusion **153** may be located at the border between the first inner surface **151a** and the second inner surface **151b**.

The inner insert **152** may be a rib extending from the side covers **35** and **36** (see FIG. 27) toward the distal end of the second inner surface **151b** of the outer cylinder **151**. The inner insert **152** may have a shape in which at least two ribs intersect. The inner insert **152** may have a first outer surface **152a** and a second outer surface **152b**. The first outer surface **152a** may be spaced apart from the first inner surface **151a** of the outer cylinder **151**, and may be parallel to the first inner surface **151a** of the outer cylinder **151**. For example, the distance G1 between the first inner surface **151a** of the outer cylinder **151** and the first outer surface **152a** of the inner insert **152** may be substantially equal to or less than the thickness of the pipe **110**. The second outer surface **152b** of the inner insert **152** may extend with a slope from the first outer surface **152a** to the distal end of the inner insert **152**. The second outer surface **152b** of the inner insert **152** may be gradually distant from the first inner surface **151a** and/or the second inner surface **151b** of the outer cylinder **151**. For example, the inner insert **152** may have a wedge shape. The second outer surface **152b** of the inner insert **152** may face the first inner surface **151a** and second inner surface **151b** of the outer cylinder **151**.

The distance G1 between the first inner surface **151a** of the outer cylinder **151** and the first outer surface **152a** of the inner insert **152** may be less than the distance G2 between the first inner surface **151a** of the outer cylinder **151** and the second outer surface **152b** of the inner insert **152**. The distance G2 between the first inner surface **151a** of the outer cylinder **151** and the second outer surface **152b** of the inner insert **152** may be less than the distance G3 between the second inner surface **151b** of the outer cylinder **151** and the second outer surface **152b** of the inner insert **152**.

Referring to FIG. 30, the pipe **110** may have a press-fitting surface **1103**. The press-fitting surface **1103** may be formed on an outer surface of the pipe **110** between the neck **1102** of the pipe **110** and the distal end of the pipe **110**. The press-fitting surface **1103** may be a coarse surface. For example, the press-fitting surface **1103** may be a knurling portion.

Referring to FIGS. 31 to 33, the pipe **110** may be inserted or press-fitted into the coupling port **150**. The protrusion **153** may be inserted into the neck **1102** of the pipe **110**. The first pipe **111**, the second pipe **112**, and the third pipe **113** may be inserted or press-fitted into their corresponding couplings **150**. Consequently, the torsional rigidity of the display device may be provided.

An auxiliary pipe **114** may face the second pipe **112** with respect to the shaft **46** of the roller **40** (see FIG. 23). The auxiliary pipe **114** may be inserted or press-fitted into the couplings **150** formed on the second frame **130** and the side cover **35**. Consequently, the torsional rigidity of the display device may be more firmly secured, and the coupling stability of the side covers may be provided.

Referring to FIG. 34, a side coupler **160** may couple the housing **30** and the side covers **35** and **36** together. The side coupler **160** may include an engaging portion **161** and a holder **162**. The engaging portion **161** may protrude inward

of the upper plate **31** of the housing **30**. The engaging portion **161** may have an engaging surface **1611** and a sloping surface **1612**. The engaging surface **1611** may extend downward from an inner surface of the upper plate **31**. The sloping surface **1612** may connect a lower end of the engaging surface **1611** and the inner surface of the upper plate **31**. The sloping surface **1612** may face the side covers **35** and **36**.

A holder **162** may be formed on an inner side of the side covers **35** and **36**. The holder **162** may include a fixing portion **1621**, an engaging groove **1622**, and stoppers **1623** and **1624**. The fixing portion **1621** may be fixed to the inner side of the side covers **35** and **36**. The stoppers **1623** and **1624** may be placed apart from the fixing portion **1621**. The engaging groove **1622** may connect the fixing portion **1621** and the stoppers **1623** and **1624**. The engaging groove **1622** may provide a space into which the engaging portion **161** is inserted. The stoppers **1623** and **1624** may have a vertical surface **1623** that faces or is in contact with the engaging surface **1611** of the engaging portion **161** of the engaging portion **161** and a guide surface **1624** where the sloping surface **1612** of the engaging portion **161** slides. A bottom surface of the engaging groove **1622** may be spaced apart from the engaging portion **161**.

The side coupler **160** may be provided on the upper plate **31**, lower plate **33**, front plate **34**, and rear plate **32** of the housing **30**. Consequently, the upper plate **31**, the lower plate **33**, the front plate **34**, and/or the rear plate and the side cover **35** and **36** may be firmly coupled together.

Referring to FIGS. 35 and 36, the lower plate **33** of the housing **30** may include an opening **33G** that extends longitudinally in the lengthwise direction of the housing **30**. The length of the opening **33G** may correspond to the breadth of the display unit **20**. For example, the length of the opening **33G** may be slightly larger than the breadth of the display unit **20**. The display unit **20** may move into or out of the housing **30** through the opening **33G**.

A board case **200** may be positioned under the housing **30**. The board case **200** may have the shape of a plate. The board case **200** may be smaller in size than the size of the display panel **21** or the module cover **23**. The board case **200** may be positioned behind the display panel **21** or the module cover **23**. An upper end of the board case **200** may be contiguous to the lower plate **33** of the housing **30**. Rails **210A** and **210B** may be mounted on one side or both sides of the board case **200**. The rails **210A** and **210B** may be formed longitudinally in the upward-downward direction of the board case **200**. The display unit **20** may move down while restrained by the rails **210** and **210B** of the board case **200**. That is, the movement of the display unit **20** may move freely upward and downward but be restrained in the front-back direction by the rails **210A** and **210B**.

The board case **200** may accommodate control boards **201** and **202**. For example, the board case **200** may accommodate a power supply unit **201**, a main board **202**, etc. The power supply unit **201** and/or the main board **202** may have the shape of a rectangular plate, and the thickness of the power supply unit **201** and/or the main board **202** may be smaller than the thickness of the board case **200**. The main board **202** may be electrically connected to the timing controller board **41** (see FIG. 10). The power supply unit **201** may supply power to the main board **202**, the timing controller board **41**, and/or the display panel **21**.

Referring to FIGS. 37 and 38, the roller **300** may move on the rails **210**. The roller **300**, along with a bottom case **60**, may move down from the housing **30** or move up toward the housing **30**. The rails **210** may include a rolling portion **211**,

11

a guide portion 213, and a restraining portion 212. The guide portion 213 may be referred to as a first side wall 213, and the restraining portion 212 may be referred to as a second side wall 212. The rolling portion 211 may form a side of the board case 200. The roller 300 may move on the rolling portion 211. The rolling portion 211 may generate rolling friction resistance against the roller 300. To prevent noise and/or vibration, the roller 30 may include urethan, for example. The roller 300 may be referred to as a holding roller 300.

The restraining portion 212 may assist the roller 300 to be vertically lowered from and/or vertically raised toward the housing 30 while moving on the rolling portion 211. The roller 300 may move on the rolling portion 211 as a side of the roller 300 is in contact with the restraining portion 212. The guide portion 213 may face the restraining portion 212 with respect to the rolling portion 211. The guide portion 213 may be opposite the restraining portion 212. The guide portion 213 may prevent the roller 300 from falling off the rolling portion 211 while moving on the rolling portion 211. The distance D between the guide portion 213 and the restraining portion 212 may be larger than the thickness of the roller 300.

Referring to FIG. 39, a roller bracket 310 may be connected or coupled to the bottom case 60. The roller 300 may be rotatably mounted to the roller bracket 310. The roller bracket 310 may have a first part 311 and a second part 312. The first part 311 may extend longitudinally in the lengthwise direction of the bottom base 60. The length of the first part 311 may be smaller than the distance d1 between a side edge of the module cover 23 and a side of the board case 200. The first part 311 may be positioned parallel to the lengthwise direction of the bottom case 60, and one end of the first part 311 may be fixed to the bottom case 60, contiguous to a side edge of the bottom case 60.

The second part 312 may extend while bending at the first part 311. The second part 312 may be bent upward from the bottom case 60 toward the housing 30 (see FIG. 35). The length of the second part 312 may be smaller than the length of the first part 311. The roller 300 may be rotatably coupled to the second part 312.

The roller 300 may include a rotating shaft 320, a rim 325, and a tire 330. The rotating shaft 320 may be fixed to the second part 312. The rim 325 may be rotatably coupled to the rotating shaft 320. A bearing (not shown) may be coupled between the rim 325 and the rotating shaft 320. The tire 330 may surround the perimeter of the rim 325. For example, the tire 330 may be urethane.

Referring to FIGS. 39 and 40, the distance W1 from the rolling portion 211 to an upper end of the restraining portion 212 may be smaller than the distance W2 from the rolling portion 211 to an upper end of the guide portion 213. The height W1 of the restraining portion 212 may be larger than the thickness of the tire 330. The restraining portion 212 may cover the side of the rim 325 as well as the side of the tire 330. The height W2 of the guide portion 213 may be larger than the thicknesses of the tire 330 and the rim 325. The guide portion 213 may cover part of the rotating shaft 320, as well as the sides of the tire 330 and the rim 325.

Referring to FIGS. 35 and 37, the roller 300 may include a first roller 300A and a second roller 300B. The roller bracket 310 may have a first roller bracket 310A and a second roller bracket 310B. The first roller bracket 310A may be coupled to a right end of the bottom case 60, and the second roller bracket 310B may be coupled to a left end of the bottom case 60. The first roller 300A may be coupled to the first roller bracket 310A and move on the first rail 210A

12

formed on the right side of the board case 200, and the second roller 300B may be coupled to the second roller bracket 310B and move on the second rail 210B formed on the left side of the board case 200. Consequently, the display unit 200 may be vertically lowered from and raised toward the housing 30.

According to an aspect of the present disclosure, there is provided a display device comprising: a flexible display panel; a panel roller which is elongated and on or from which the display panel is wound or unwound; a housing in which the panel roller is accommodated, wherein while the display panel is unwound from the panel roller, the display panel descends below the housing; and a board case which is disposed behind the display panel descending below the housing, and of which the front surface is covered by the display panel while the display panel descends.

According to another aspect of the present disclosure, the display device further comprises: a rail formed in an upward-downward direction of the board case; a bottom case placed contiguous to a lower side of the display panel and coupled to the display panel; and a holding roller fixed to the bottom case and moving on the rail.

According to another aspect of the present disclosure, the holding roller includes: a roller bracket having a first part coupled to a rear surface of the bottom case and a second part extending from the first part and positioned contiguous to the rail; a rotating shaft formed on the second part; a rim rotatably coupled to the rotating shaft; and a tire formed around the perimeter of the rim and making contact with the rail.

According to another aspect of the present disclosure, the rail includes: a rolling portion that rolls in contact with the tire; a restraining portion that makes contact with a side of the tire facing the display panel; and a guide portion facing the restraining portion with respect to the rolling portion.

According to another aspect of the present disclosure, the distance between the restraining portion and the guide portion is larger than the width of the tire.

According to another aspect of the present disclosure, the height from the rolling portion to an upper end of the restraining portion is smaller than the height from the rolling portion to an upper end of the guide portion.

According to another aspect of the present disclosure, the display device of claim further comprises: a first pipe extending longitudinally in the lengthwise direction of the panel roller, and positioned contiguous to the panel roller inside the housing; a second pipe extending longitudinally in the lengthwise direction of the panel roller, positioned contiguous to the panel roller inside the housing, and facing the first pipe with respect to the panel roller; a third pipe extending longitudinally in the lengthwise direction of the panel roller, and positioned contiguous to the panel roller between the first pipe and the second pipe inside the housing; and a guide roller extending longitudinally in the lengthwise direction of the panel roller, and facing the third pipe with respect to the panel roller inside the housing, wherein the display panel is wound around or unwound from the panel roller while passing between the first pipe and the guide roller.

According to another aspect of the present disclosure, the board case is positioned contiguous to the guide roller.

According to another aspect of the present disclosure, the display device comprises: a main board that supplies an electrical signal to the display panel; and a power supply unit that supplies power to the main board or the display panel, wherein the main board and the power supply unit are accommodated in the board case.

13

According to another aspect of the present disclosure, the display device further comprises a timing controller board positioned inside the panel roller, wherein the main board supplies an electrical signal to the timing controller board.

Consequently, it is possible to improve bending of the display panel 21 which may occur when the display unit 20 is wound around or unwound from the panel roller 40 and the display unit 21 moves down from the housing 30.

Certain embodiments or other embodiments of the disclosure described above are not mutually exclusive or distinct from each other. Configurations or functions of embodiments of the disclosure described above may be used together or combined with each other.

For example, a configuration "A" described in one embodiment of the disclosure and the drawings and a configuration "B" described in another embodiment of the disclosure and the drawings may be combined with each other. Namely, although the combination between the configurations is not directly described, the combination is possible except in the case where it is described that the combination is impossible.

The above detailed description should not be construed as restrictive in all respects and should be considered as illustrative. The scope of the present invention should be determined by reasonable interpretation of the appended claims, and all modifications within the equivalent scope of the present invention are included in the scope of the present invention.

What is claimed is:

1. A display device comprising:

- a flexible display panel;
- a panel roller which is elongated and on or from which the display panel is configured to be wound or unwound;
- a housing in which the panel roller is accommodated, wherein while the display panel is unwound from the panel roller, the display panel descends below the housing;
- a board case which is disposed behind the display panel descending below the housing, and having a front surface which is covered by the display panel while the display panel descends;
- a rail formed in an upward-downward direction of the board case;
- a bottom case placed contiguous to a lower side of the display panel and coupled to the display panel; and
- a holding roller fixed to the bottom case and moving on the rail, wherein the holding roller includes:
 - a roller bracket having a first part coupled to a rear surface of the bottom case and a second part extending from the first part and positioned contiguous to the rail;
 - a rotating shaft formed on the second part;

14

a rim rotatably coupled to the rotating shaft; and
 a tire formed around the perimeter of the rim and configured to make contact with the rail.

2. The display device of claim 1, wherein the rail includes:

- a rolling portion that rolls in contact with the tire;
- a restraining portion that makes contact with a side of the tire facing the display panel; and
- a guide portion facing the restraining portion with respect to the rolling portion.

3. The display device of claim 2, wherein the distance between the restraining portion and the guide portion is larger than the width of the tire.

4. The display device of claim 3, wherein the height from the rolling portion to an upper end of the restraining portion is smaller than the height from the rolling portion to an upper end of the guide portion.

5. The display device of claim 1, further comprising:

- a first pipe extending longitudinally in a lengthwise direction of the panel roller, and positioned contiguous to the panel roller inside the housing;
- a second pipe extending longitudinally in the lengthwise direction of the panel roller, positioned contiguous to the panel roller inside the housing, and facing the first pipe with respect to the panel roller;
- a third pipe extending longitudinally in the lengthwise direction of the panel roller, and positioned contiguous to the panel roller between the first pipe and the second pipe inside the housing; and
- a guide roller extending longitudinally in the lengthwise direction of the panel roller, and facing the third pipe with respect to the panel roller inside the housing, wherein the display panel is wound around or unwound from the panel roller while passing between the first pipe and the guide roller.

6. The display device of claim 5, wherein the board case is positioned contiguous to the guide roller.

7. The display device of claim 1, comprising:

- a main board that supplies an electrical signal to the display panel; and
- a power supply unit that supplies power to the main board or the display panel, wherein the main board and the power supply unit are accommodated in the board case.

8. The display device of claim 7, further comprising a timing controller board positioned inside the panel roller, wherein the main board supplies an electrical signal to the timing controller board.

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